Lumenera USB & GigE Cameras User's Manual

Release 6.0

Lumenera corporation

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This unit is for use only with compatible UL listed devices.

If the unit is powered via an external power adapter, the powered adapter shall be UL listed with LPS output.

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Should the unit fail during the warranty period, Lumenera will, at its option, repair or replace the failed unit. Repaired or replaced units will be covered under warranty for the remainder of the original one (1) year warranty period.

This warranty does not apply to units that, after being inspected by Lumenera, have been found to have failed due to customer abuse, accidents, mishandling, tampering/alteration, improper installation, improper power source, negligence, opening of the enclosure, or if the serial number has been removed or damaged. This warranty does not cover labour or incurred charges required in removing or installing the unit, any business interruption, loss of profits/revenues, or any consequential damages.

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Any returning product, specifically those being returned under warranty, must follow the Returned Material Authorization (RMA) process. Any units being returned are to be properly packaged (in original packing – if possible). Lumenera will not cover damage sustained in shipping due to improper packing.

For RMA instructions please refer to our website at www.lumenera.com.

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The Waste Electrical and Electronic Equipment Directive (WEEE) aims to reduce the waste arising from electrical and electronic equipment and to improve the environmental performance of all those involved in the life cycle of these products.

Lumenera is committed to protecting people and the environment and we are working on identifying any materials used in our processes that could pose a potential hazard to our employees, customers or the environment.

For this reason we are committed to have all our products comply with the RoHS and WEEE directives. We are constantly improving our compliance with these directives. For more information on our compliance or to track our progress please refer to our website.

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Table of Contents

TABLE OF CONTENTS 3
1 INTRODUCTION 1
1.1 THE LUMENERA USB AND GIGE CAMERA FAMILY 1
2 INSTALLING AND USING THE CAMERA 2
2.2 CAMERA AND SOFTWARE INSTALLATION 2
2.2.1 Minimum System Requirements 2
2.2.2 Camera Power Requirements 2
2.2.3 USB Camera Installation Procedure 3
2.2.4 GigE Cameras Installation Procedure 7
2.2.5 USB Plug-and-Play Device Recognition 13
2.2.6 Software Upgrade Procedure 13
2.2.7 USB Camera Troubleshooting 14
2.3 TECHNICAL ASSISTANCE 17
2.4 USING THE INSTALLED SOFTWARE 17
2.4.1 Drivers & INF 17
2.4.2 DirectShow Filters 18
2.4.3 Application Software 18
2.4.4 Sample Application Executables 18
2.4.5 Software Development Kit (SDK) 18
2.4.6 Documentation 19
2.4.7 Driver Only Installation Packages 19
2.5 USING LUCAM & LGCAM CAPTURE 19
2.5.1 Dialog Items 20
2.5.2 View Menu Items 21
2.5.3 Options Menu Items 21
2.5.4 Buttons and Interface Controls 22
2.5.5 Snapshot Settings 22
3 UNDERSTANDING YOUR CAMERA 23
3.6 SHUTTER TYPES 23
3.6.1 Rolling Shutter 23
3.6.2 Half Global Shutter 23
3.6.3 Global Shutter 23
3.7 SCANNING MODE 24
3.7.1 Progressive Scan 24
3.7.2 Interlaced Scan 24
3.8 USE OF FLASH OR STROBE 25
3.8.1 Flash with Rolling Shutter 25
3.8.2 Flash with Half Global Shutter 26
3.8.3 Flash with Global Shutter 26
3.9 CAMERA MODES 26
3.9.1 Streaming Video 26
3.9.2 Snapshot (Asynchronous Trigger) 26
3.10 DATA FORMAT 26
3.11 SUBWINDOWING, SUBSAMPLING & BINNING 28
3.12 EXTERNAL I/O INTERFACE 29
3.12.1 Standard LuCam Camera GPI/O Interface Description 29
3.12.2 LuCam Large Format Camera GPI/O Interface Description 31

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3.12.3 GPI/O Descriptions and Signal Definitions for Mini Cameras 32
3.12.4 Gigabit Cameras GPI/O's Interface Description 34
3.12.5 Signal Definitions for All Cameras 34
3.12.6 USB Tether Connector 36
3.12.7 Taking a Single-Frame Snapshot with the Camera External I/O Interface 36
3.13 EXTERNAL POWER 39
3.14 LENS MOUNT 41
3.15 CAMERA IDS 41

4 SDK SAMPLE APPLICATIONS 42

4.16 GENERAL OVERVIEW 42
4.17 DESCRIPTION OF SAMPLE APPLICATIONS 43
4.17.1 AutoLens Sample Application 43
4.17.2 Auto Properties Sample Application 44
4.17.3 AVI Sample Application 45
4.17.4 Blank Camera Sample Application 46
4.17.5 Callback Sample Application 47
4.17.6 CaptureToFile Sample Application 48
4.17.7 ClickCrop Sample Application 49
4.17.8 DirectShow Callback Sample Application 50
4.17.9 DirectX Sample Application 51
4.17.10 DirectX Snapshot Sample Application 52
4.17.11 Dual Slope Sample Application 53
4.17.12 Dual Snapshot Application 54
4.17.13 DX Control Sample Application 55
4.17.14 Enum Frame Rates Sample Application 56
4.17.15 Fast Synch Snaps Sample Application 57
4.17.16 Flipping Sample Application 58
4.17.17 Frame Rate Sample Application 59
4.17.18 Get 16-bit Info Sample Application 60
4.17.19 Get Ranges Sample Application 61
4.17.20 GPI Event Sample Application 62
4.17.21 GPI0 Test Sample Application 63
4.17.22 HiDy Sample Application 64
4.17.23 Histogram Sample Application 65
4.17.24 HwTrigCount Sample Application 66
4.17.25 Infinity Test Sample Application 66
4.17.26 Lucam Capture Sample Application 66
4.17.27 Mono Check Sample Application 66
4.17.28 Picture Flip Application 67
4.17.29 Perm Storage Sample Application 68
4.17.30 ResetAndFF Sample Application 68
4.17.31 Scrolling Preview Sample Application 68
4.17.32 Snapshot Sample Application 69
4.17.33 Threshold Sample Application 70
4.17.34 WinConsole Sample Application 70

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1 Introduction

1.1 The Lumenera USB and GigE Camera Family

Lumenera cameras provide a quick and easy means of displaying and capturing high quality video preview and captured images on any USB 2.0 or GigE-equipped desktop, laptop or embedded computer.

Designed with flexibility in mind, each camera model has its own distinct characteristics and performance advantages over the others, whether speed, resolution, image quality, sensitivity or price. Because they are USB and GigE-based, there is no need for a framegrabber. Instead, a single cable provides full command and control and data transfer at speeds of up to 24 MB/s (Lu series), 48 MB/s (Lw series) or 100 MB/s (Lg series). For the majority of the camera models, the same cable supplies the camera with power (5V).

Most cameras have a provision to be externally powered for cases where the USB cable does not supply sufficient power (e.g. some USB cards on laptop computers). GigE products and large format cameras require an external power supply.

All cameras share the same simple, yet powerful API allowing easy migration from one camera model to another. Both board-level and enclosed cameras are available. All cameras also have an optional external interface header for hardware input and output signals and on-board memory for image buffering.

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2 Installing and Using the Camera

2.2 Camera and Software Installation

The Lumenera camera you have just purchased is designed to operate out of the box with minimal set-up.

Note: Prior to plugging the camera into the computer, you must first install the software. In the event that the camera was connected to the computer prior to the software being installed, it will be necessary to perform some manual setup using the Windows Device Manager following the software install. Refer to the trouble-shooting section of this manual for the necessary instructions.

The software can be found on the Lumenera website at http://www.lumenera.com/support/downloads/industrial-downloads.php.

2.2.1 Minimum System Requirements

- Windows XP (SP 3) or Windows VISTA or Windows 7
- 32 and 64-bit platforms are supported
- 1.0 GHz Pentium III or higher (compatible)
- 512 MB RAM
- USB 2.0 or GigE port.

Note for USB products: A USB 2.0 Port is required. The camera will not work on a standard USB 1.1 port.

2.2.2 Camera Power Requirements

Most camera models run directly off the USB bus for power supply, command control, and data output. In some cases and/or camera models, there may be a need to externally power the camera. Large format cameras (Lw1105x, Lw1605x) and GigE cameras run off the external power supply only. Please refer to Section 3.13 for more information on selecting the appropriate power supply for your camera. If an incorrect external power supply is used, it could damage the camera and void your warranty.

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2.2.3 USB Camera Installation Procedure

Lumenera's USB 2.0 high-speed cameras are designed to operate straight out of the box. **However, prior to plugging the camera into the computer it is recommended that you first install the software**, which is available at http://www.lumenera.com/support/downloads/industrial-downloads.php.

Follow the steps below for simple installation:

1. Ensure you are logged into the computer with administrator privileges prior to continuing the installation.
2. Download the latest version of the LuCam Software from the Lumenera Industrial Camera Downloads web page (http://www.lumenera.com/support/downloads/industrial-downloads.php).
3. Close all running application software then execute the latest LuCam software package previously downloaded by double-clicking on the installation program. The camera should NOT be connected to the computer at this point.
4. Double-click on the installation program, or wait a few moments for the auto-play function to load the setup program automatically, when downloading the software.
5. Follow the onscreen prompts to install the software drivers and user application. The installation script steps are the same whether the installation takes place on a Windows XP, Windows VISTA, or Windows 7 platforms, 32 or 64-bit.

The following screen capture images provide a walk-through of the installation procedure:

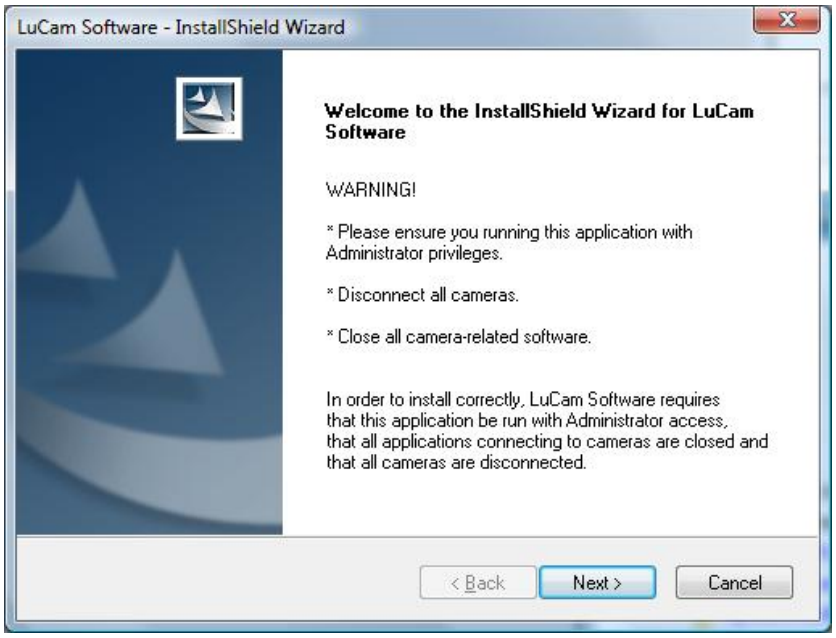
LuCam Software - InstallShield Wizard
Welcome to the InstallShield Wizard for LuCam Software
WARNING!
* Please ensure you running this application with Administrator privileges.
* Disconnect all cameras.
* Close all camera-related software.
In order to install correctly, LuCam Software requires that this application be run with Administrator access, that all applications connecting to cameras are closed and that all cameras are disconnected.
< Back
Next >
Cancel

Figure 1: Welcome Installshield Wizard Window

Ensure that cameras are disconnected and click **Next.**

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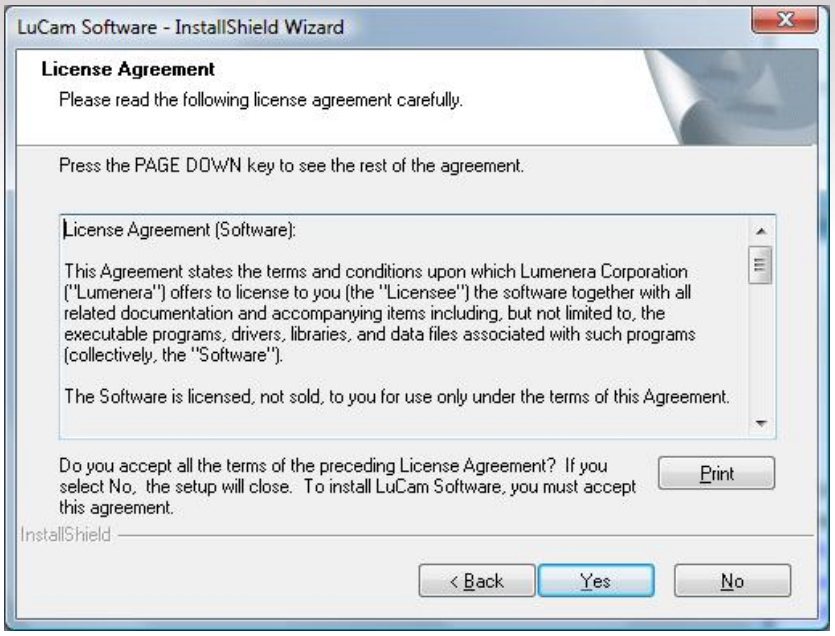
LuCam Software - InstallShield Wizard
License Agreement
Please read the following license agreement carefully.
Press the PAGE DOWN key to see the rest of the agreement.
License Agreement (Software):
This Agreement states the terms and conditions upon which Lumenera Corporation ("Lumenera") offers to license to you (the "Licensee") the software together with all related documentation and accompanying items including, but not limited to, the executable programs, drivers, libraries, and data files associated with such programs (collectively, the "Software").
The Software is licensed, not sold, to you for use only under the terms of this Agreement.
Do you accept all the terms of the preceding License Agreement? If you select No, the setup will close. To install LuCam Software, you must accept this agreement.
Print
InstallShield
< Back
Yes
No

Figure 2: License Agreement

Review the License Agreement and click **Next.**

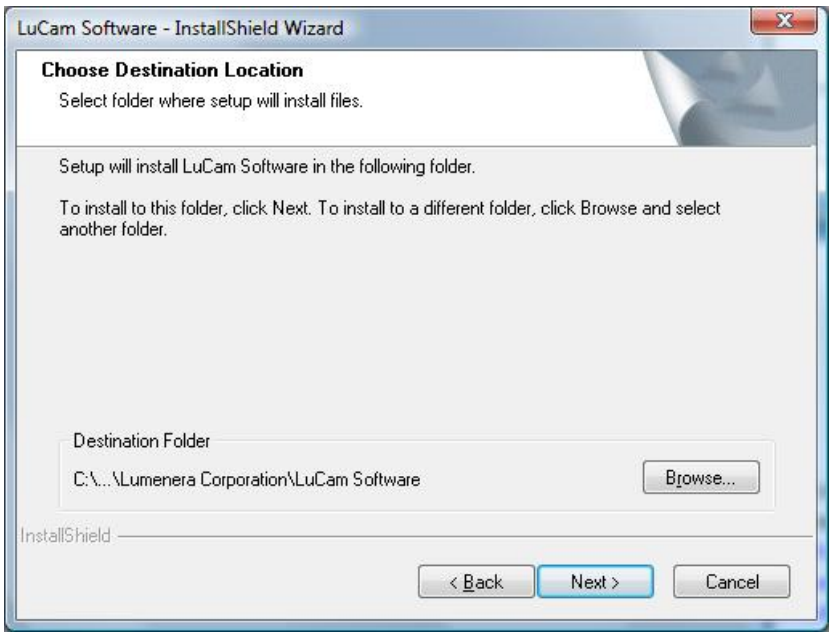
LuCam Software - InstallShield Wizard
Choose Destination Location
Select folder where setup will install files.
Setup will install LuCam Software in the following folder.
To install to this folder, click Next. To install to a different folder, click Browse and select another folder.
Destination Folder
C:\...\Lumenera Corporation\LuCam Software
Browse...
InstallShield
< Back
Next >
Cancel

Figure 3: Choose Destination Location

Use the **Browse** button if an alternate installation folder is desired, otherwise click **Next** to continue.

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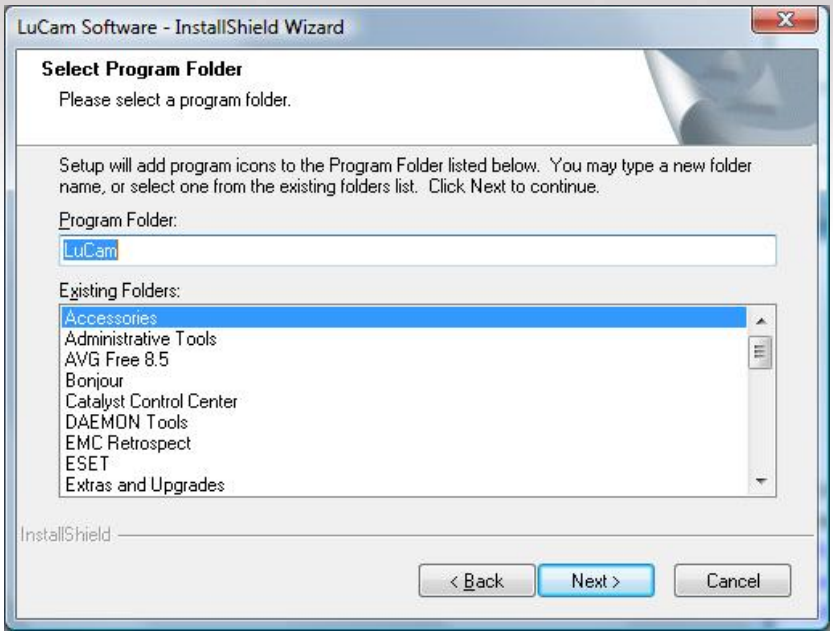

Figure 4: Program Folder Options

Click **Next** to accept the default Program Folder name.

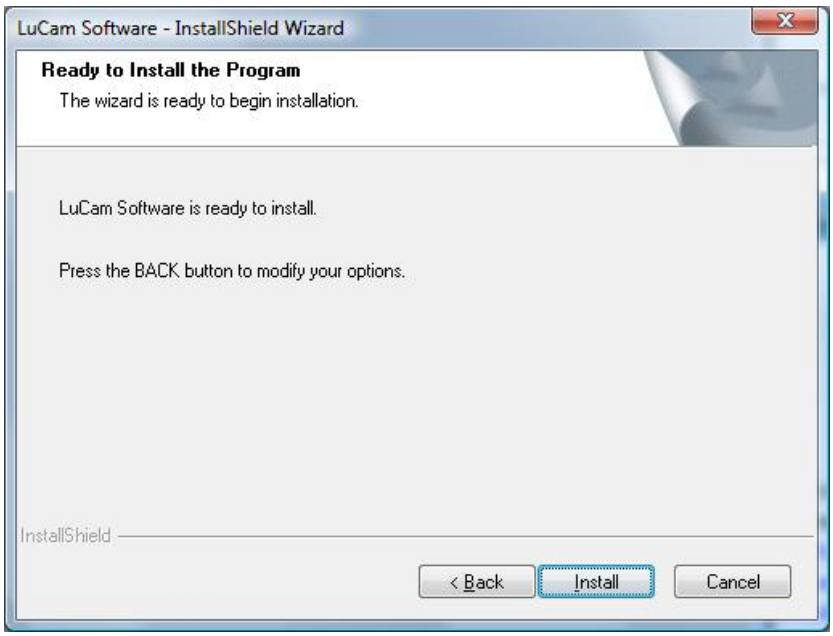
LuCam Software - InstallShield Wizard
Ready to Install the Program
The wizard is ready to begin installation.
LuCam Software is ready to install.
Press the BACK button to modify your options.
InstallShield
< Back
Install
Cancel

Figure 5: Ready to Install Program

Click **Install** to continue.

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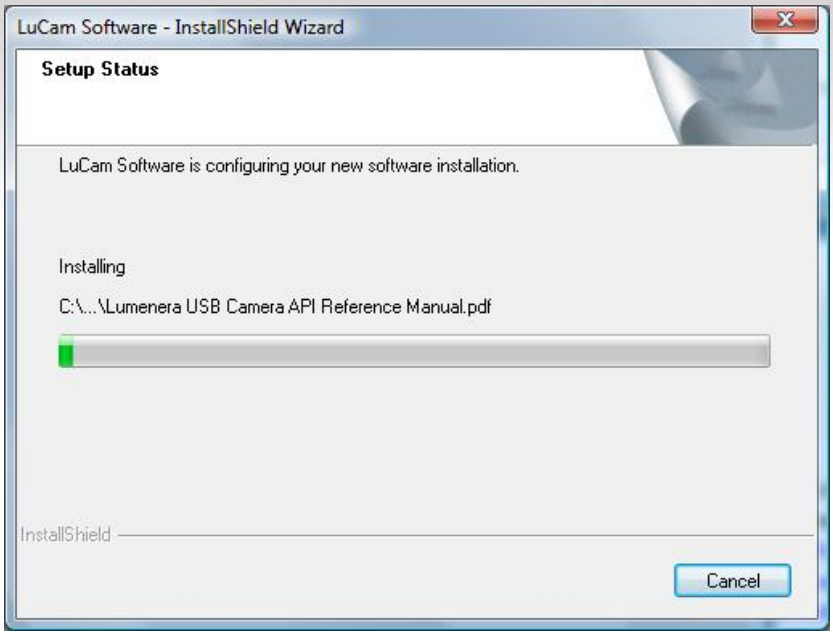

Figure 6: Installation Status

The installation progress bar updates as the listed files are installed.

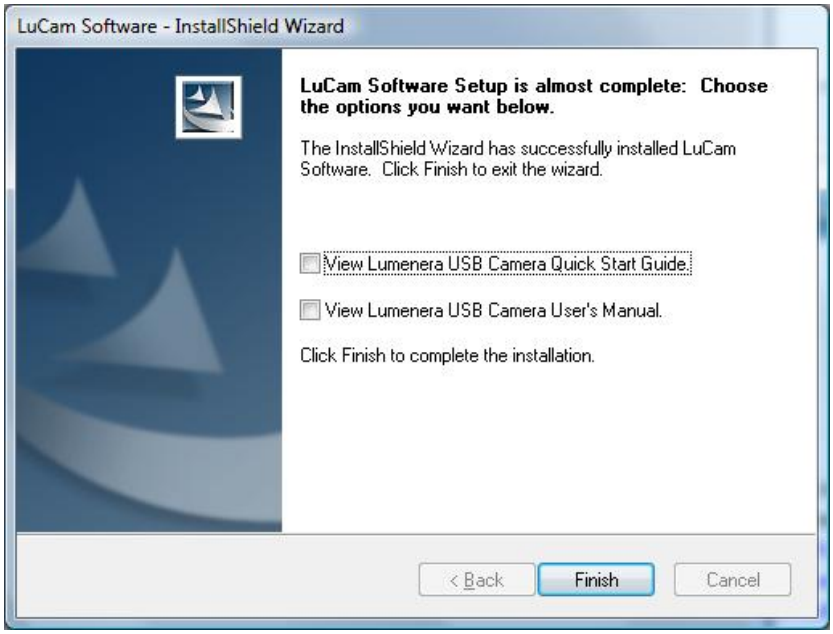
LuCam Software - InstallShield Wizard
LuCam Software Setup is almost complete: Choose the options you want below.
The InstallShield Wizard has successfully installed LuCam Software. Click Finish to exit the wizard.
View Lumenera USB Camera Quick Start Guide.
View Lumenera USB Camera User's Manual.
Click Finish to complete the installation.
< Back
Finish
Cancel

Figure 7: Last step of the USB installation

Select any of the options on this final dialog prior to clicking **Finish.**

After the software has been installed, plug the USB 2.0 camera into a free USB 2.0 high-speed port.

Note: The first time a USB camera is connected to any USB port on the computer, the user must be logged into an account with Administrator rights. Once the PC recognizes a camera in a specific port, the camera can be disconnected and reconnected by a user with non-administrator privileges.

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Before the camera becomes operational, the operating system must load the device drivers. The LED on the camera will not illuminate until the camera drivers have been successfully loaded to the camera.

2.2.4 GigE Cameras Installation Procedure

1. Ensure you are logged into the computer with administrator privileges prior to continuing the installation.
2. Download the latest version of the LgCam Software from the Lumenera Industrial Camera Downloads web page (http://www.lumenera.com/support/downloads/industrial-downloads.php).
3. Close all running application software then execute the latest LgCam software package previously downloaded by double-clicking on the installation program. The camera should NOT be connected to the computer at this point.
4. Follow the onscreen prompts to install the software drivers and user application. The installation script steps are the same whether the installation takes place on a Windows XP, Windows VISTA, or Windows 7 platforms, 32 or 64-bit.
5. On a Windows VISTA or Windows7 computer, you may see the warning shown above if the UAC (User Access Control) is enabled. Respond by clicking the Yes button.

The following screen capture images provide a walk-through of the installation procedure:

User Account Control
Do you want to allow the following program from an unknown publisher to make changes to this computer?
Program name: LgCamSetup.exe
Publisher: Unknown
File origin: Network drive
Show details
Yes
No
Change when these notifications appear

Figure 8: User Account Control Warning Message

The installation starts with a welcome dialog box. Click **Next** to continue with the installation of the LgCam software.

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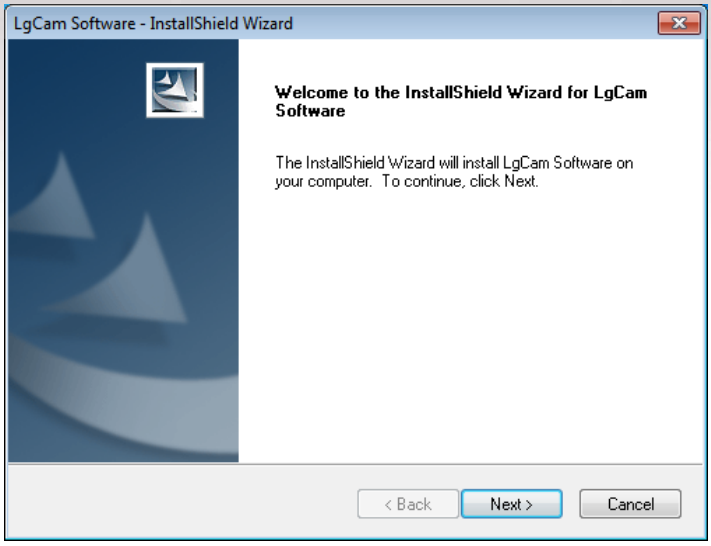
LgCam Software - InstallShield Wizard
Welcome to the InstallShield Wizard for LgCam Software
The InstallShield Wizard will install LgCam Software on your computer. To continue, click Next.
< Back
Next >
Cancel

Figure 9: LgCam Install Welcome Screen

Read the license agreement, accept and click **Next** to continue.

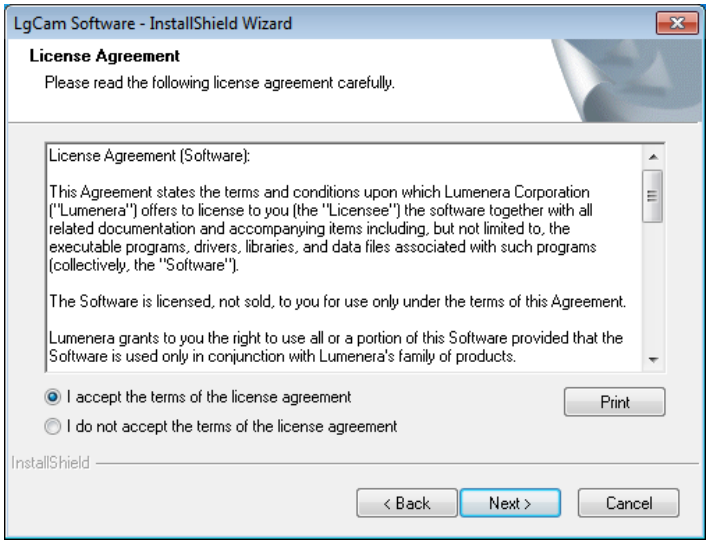
LgCam Software - InstallShield Wizard
License Agreement
Please read the following license agreement carefully.
License Agreement (Software):
This Agreement states the terms and conditions upon which Lumenera Corporation ("Lumenera") offers to license to you (the "Licensee") the software together with all related documentation and accompanying items including, but not limited to, the executable programs, drivers, libraries, and data files associated with such programs (collectively, the "Software").
The Software is licensed, not sold, to you for use only under the terms of this Agreement.
Lumenera grants to you the right to use all or a portion of this Software provided that the Software is used only in conjunction with Lumenera's family of products.
I accept the terms of the license agreement
I do not accept the terms of the license agreement
Print
InstallShield
< Back
Next >
Cancel

Figure 10: License Agreement

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It is recommended that you select the **complete** install option and click **Next** to complete installation settings.

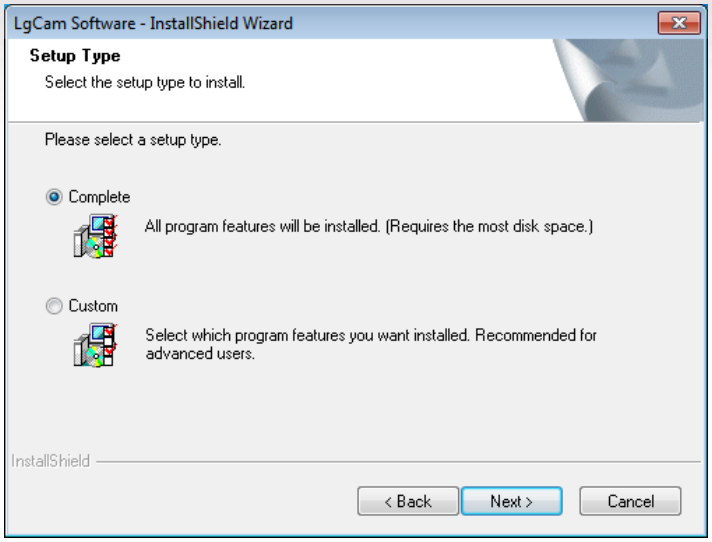
LgCam Software - InstallShield Wizard
Setup Type
Select the setup type to install.
Please select a setup type.
Complete
All program features will be installed. (Requires the most disk space.)
Custom
Select which program features you want installed. Recommended for advanced users.
InstallShield
< Back
Next >
Cancel

Figure 11: LgCam Installation type

Click **Install** to begin the software installation process.

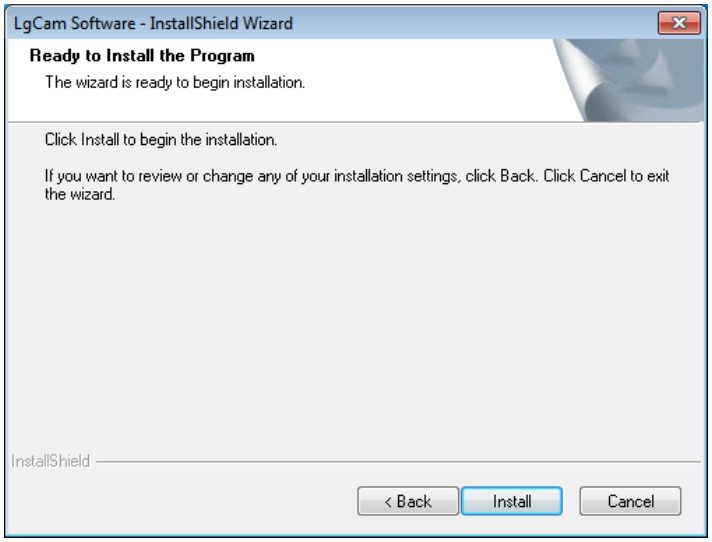
LgCam Software - InstallShield Wizard
Ready to Install the Program
The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield
< Back
Install
Cancel

Figure 12: LgCam Ready to Install

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The first message box is a friendly warning letting you know that the installation may take several minutes. Click **OK** to continue.

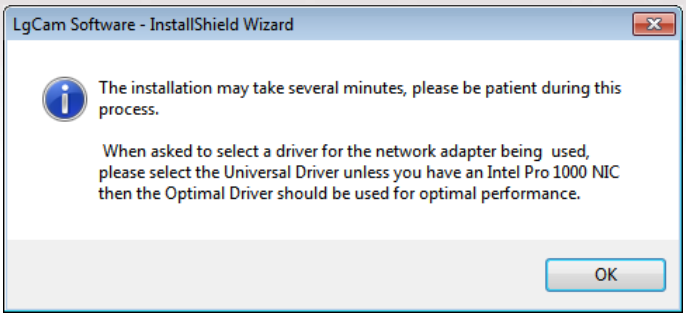
LgCam Software - InstallShield Wizard
The installation may take several minutes, please be patient during this process.
When asked to select a driver for the network adapter being used, please select the Universal Driver unless you have an Intel Pro 1000 NIC then the Optimal Driver should be used for optimal performance.
OK

Figure 13: Installation may take several minutes

The next pop-up message will prompt the installation of LgCam 32-bit drivers.

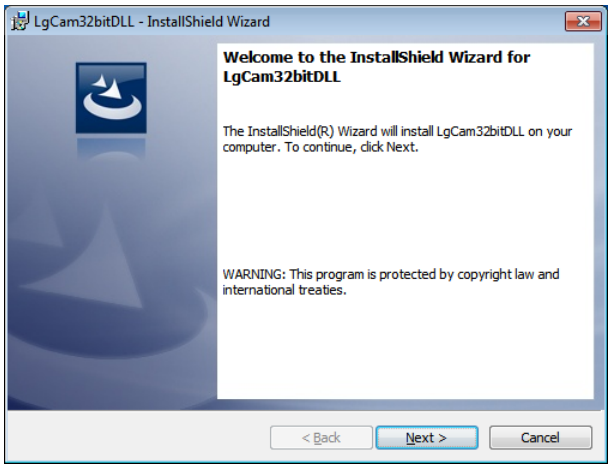
LgCam32bitDLL - InstallShield Wizard
Welcome to the InstallShield Wizard for LgCam32bitDLL
The InstallShield(R) Wizard will install LgCam32bitDLL on your computer. To continue, click Next.
WARNING: This program is protected by copyright law and international treaties.
< Back
Next >
Cancel

Figure 14: 32 Bit Drivers Installation Welcome Screen

Click **Next** to continue, then select **Install**.

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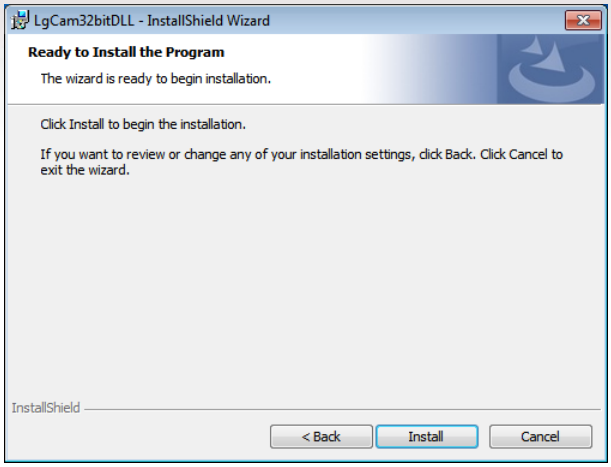
LgCam32bitDLL - InstallShield Wizard
Ready to Install the Program
The wizard is ready to begin installation.
Click Install to begin the installation.
If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.
InstallShield
< Back
Install
Cancel

Figure 15: 32-Bit Drivers Installation

Once the 32-bit drivers are installed on your computer, press **Finish.** Please note that on 64-bit computers this step will be repeated for the 64-bit driver installation

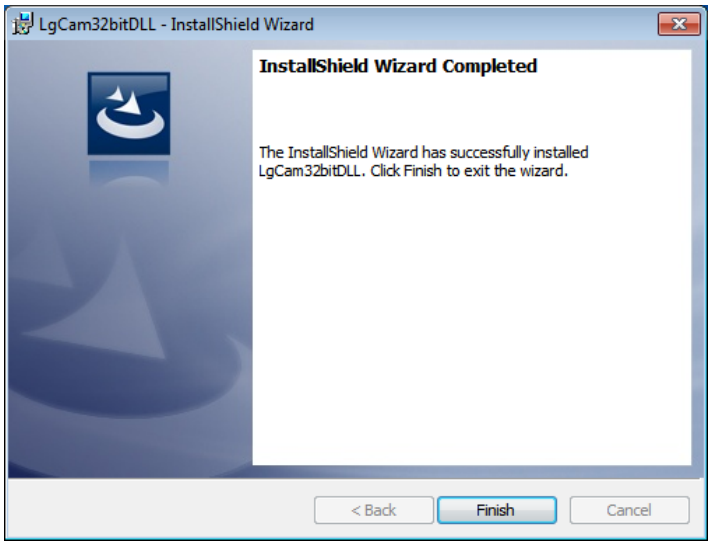
LgCam32bitDLL - InstallShield Wizard
InstallShield Wizard Completed
The InstallShield Wizard has successfully installed LgCam32bitDLL. Click Finish to exit the wizard.
< Back
Finish
Cancel

Figure 16: 32-Bit Installation Drivers Completed

During the package installation, the **eBUS Driver Installation Tool** will launch automatically as shown in Figure 17 below. Select **Install eBUS Universal Driver** from the drop-down list under Action. Install this driver for the network interface card (NIC) that will be used to connect to the camera. Select **Do Nothing** for all other NICs, and then click the **Install** button. If your system has an Intel® PRO/100 network interface card then select **Optimize Driver** instead of the universal one.

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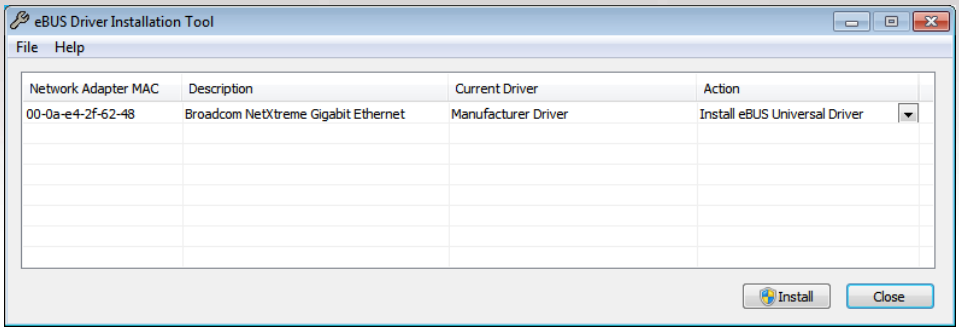

Figure 17: eBUS Driver settings

Should either of the following warning messages appear click **Continue Anyway**.

Software Installation
The software you are installing has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the software vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation
Hardware Installation
The software you are installing for this hardware:
Ethernet Bus Filter Miniport
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

Figure 18: Unsigned Driver Warning

When the dialog box below appears the LgCam software installation is complete. In order to use the GigE Vision camera the computer must be restarted (therefore select restart the computer now) and then click **Finish** to close the window.

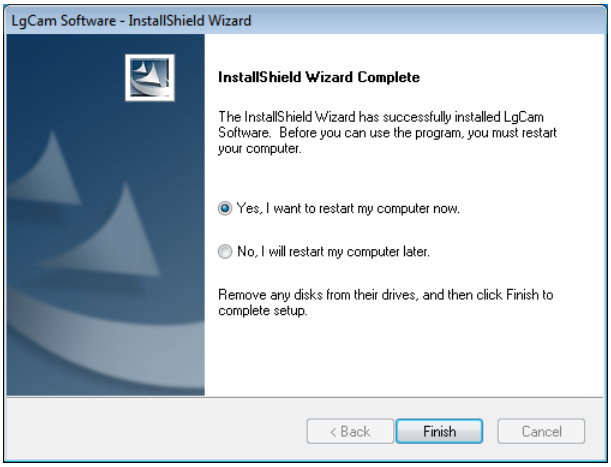
LgCam Software - InstallShield Wizard
InstallShield Wizard Complete
The InstallShield Wizard has successfully installed LgCam Software. Before you can use the program, you must restart your computer.
Yes, I want to restart my computer now.
No, I will restart my computer later.
Remove any disks from their drives, and then click Finish to complete setup.
< Back
Finish
Cancel

Figure 19: LgCam Installation Completed

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2.2.5 USB Plug-and-Play Device Recognition

Windows 2000 & XP Systems:

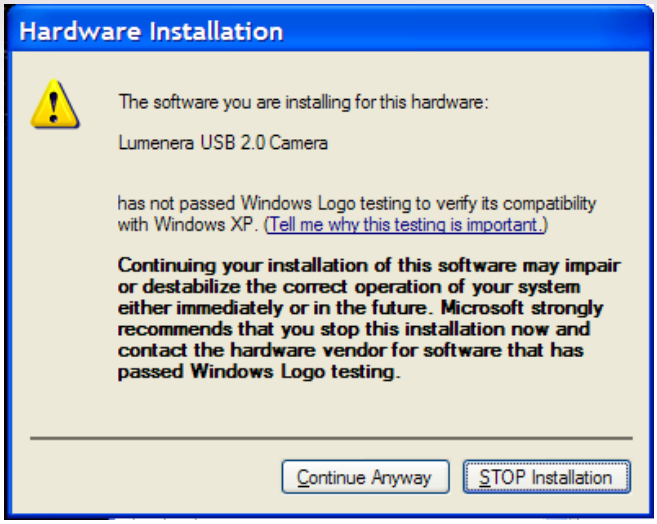
Hardware Installation
The software you are installing for this hardware:
Lumenera USB 2.0 Camera
has not passed Windows Logo testing to verify its compatibility with Windows XP. (Tell me why this testing is important.)
Continuing your installation of this software may impair or destabilize the correct operation of your system either immediately or in the future. Microsoft strongly recommends that you stop this installation now and contact the hardware vendor for software that has passed Windows Logo testing.
Continue Anyway
STOP Installation

Figure 20: Hardware Installation

a. The Window's New Hardware Wizard will pop-up detecting a new "Lumenera Unconfigured Device". Select "**Install the software automatically**" from the options that are presented, and click **Next**. A warning may appear notifying you that the drivers have not been digitally signed by Microsoft. Click **Continue Anyway** to continue with the driver installation, then click **Finish** to install the drivers.

   After a few seconds the Window's New Hardware Wizard will pop-up again (if it doesn't, unplug and re-plug the camera device), detecting a "Lumenera xxxxx Camera" device. Select "Install the software automatically" from the options that are presented and click **Next**. A warning may appear notifying you that the drivers have not been digitally signed by Microsoft. Click Continue Anyway to continue with the driver installation. Then click **Finish** to install the drivers. (Please Note: Depending on the camera model purchased the string "Mega 092" may be different than noted above).

b. **Important:** Windows will ask you to re-run these steps each time you plug the camera into a **new** USB 2.0 port. You must have administrator privileges the first time the camera is used on any given USB 2.0 port. You may wish to repeat these installation steps at this time for all USB 2.0 ports.

Windows VISTA and Windows 7 Systems:

The Lumenera USB camera drivers are digitally signed with Microsoft. Under the Windows VISTA and Windows 7 operating systems the camera will be automatically identified, and the drivers will be silently loaded in the background. Typically a small balloon dialog appears in the lower right hand side of the screen indicating that a device has been detected and the drivers are loading. Allow up to 1 minute for the device drivers to load, and when the LED is illuminated on the camera it is operational.

Run the LuCam Capture application software from your Start menu to control the camera.

2.2.6 Software Upgrade Procedure

The Software Upgrade procedure is similar to the original software installation. If you have installed a previous version of the software you should uninstall it prior to running the Software Upgrade.

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Note: Should the Uninstall Script identify that a reboot is required, please ensure that you perform this step by rebooting your computer before installing the Software Upgrade. Failure to do so could cause difficulties with any future installations.

If you run the Software Upgrade without uninstalling the older version, it will uninstall it for you. The Software Upgrade procedure will launch automatically to install the new software, immediately following the un-install.

2.2.7 USB Camera Troubleshooting

In the event that the Lumenera USB camera is not functional, the most likely reason is that the drivers were not loaded to the camera. This can occur when a camera was connected to the PC prior to the software being installed. When the USB plug-and-play device detection is initiated for any new device, the operating system will effectively quarantine the device if it cannot locate the appropriate driver files. In this event, the camera drivers will be blocked from loading even after the drivers are installed, unless the device detection process is invoked manually. The steps to correct this only take a couple of minutes to complete.

Make sure that the Lucam software is installed before proceeding.

1) Right mouse click the “My Computer” icon on your computer screen and choose “Properties”. Click “Device Manager” on System Properties window.

A keyboard shortcut exists to access this menu quickly, press the “Windows / Start” key and the “Pause / Break” keys simultaneously:

Figure 21: Shortcut System Manager

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System Properties
System Restore
Automatic Updates
Remote
General
Computer Name
Hardware
Advanced
Device Manager
The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.
Device Manager
Drivers
Driver Signing lets you make sure that installed drivers are compatible with Windows. Windows Update lets you set up how Windows connects to Windows Update for drivers.
Driver Signing
Windows Update
Hardware Profiles
Hardware profiles provide a way for you to set up and store different hardware configurations.
Hardware Profiles
OK
Cancel
Apply

Figure 22: System Manager

2) Find the entry in the list with a yellow question mark (?). See example below. It will likely be located under one of these headings.

a. Other Devices
b. Universal Serial Bus controllers
c. Unconfigured Device
d. Imaging Devices Section

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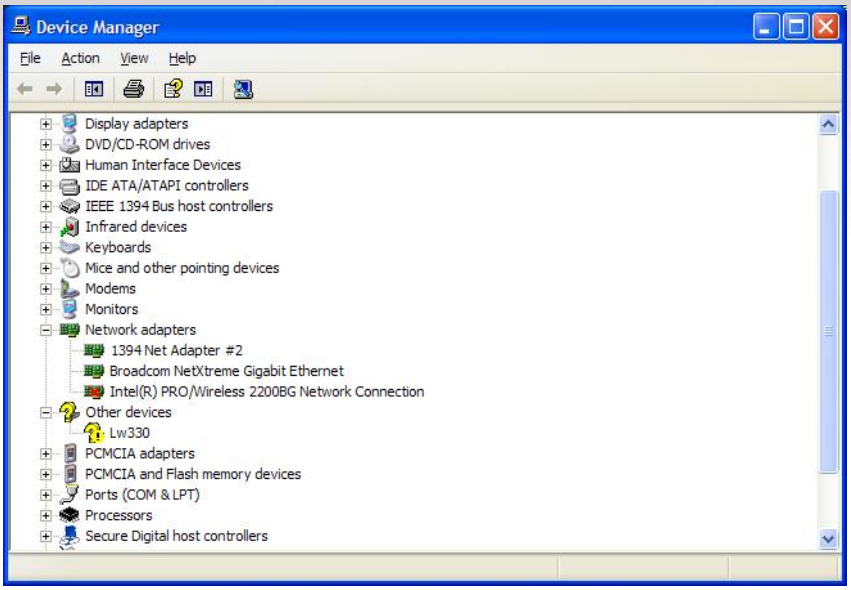
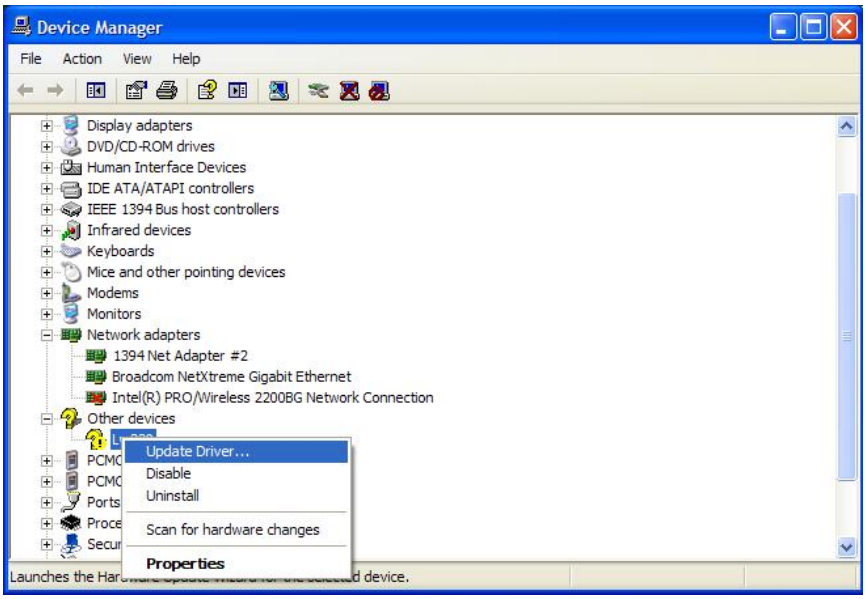


3) Right-click on this entry and select Update Driver.



The Windows Found New Hardware Wizard run is launched and the normal camera installation steps should be followed.

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2.3 Technical Assistance

If you need assistance with the installation, use of the software or if you require help with general camera operation please contact the Technical Assistance Centre (TAC) via email at:

support@lumenera.com

or by phone at +1-613-736-4077 (press 2 from the auto attendant)

To obtain the latest software release and other technical information visit the technical support tab on the Lumenera website at:

www.lumenera.com

Our support website contains technical information available to the general public such as Frequently Asked Questions (FAQ's). For our Lumenera customers we provide a Knowledge Base with more product-specific solutions and a Download Centre for customers to obtain the most recent software releases.

As a customer you will need to provide the TAC with some basic information to gain access to the customer Knowledge Base and the Download Centre. Please provide the following details via email to support@lumenera.com to obtain a user name and password:

- Name, company name, address and telephone number
- Camera model and serial number
- Purchase information (e.g. did you purchase from an OEM or distributor?)
- SDK password that was provided to you if SDK was purchase or the proof of its purchase.

Upon providing the above information, you will receive your access information via email from a TAC representative.

2.4 Using the Installed Software

All of the necessary software and device drivers are contained in an installation program available on the Lumenera website under the Support section.

The following files are installed when you run the installation program:

2.4.1 Drivers & INF

The Lumenera camera driver files come as a pair for each camera model, supporting a two-stage driver load process. These two files have the .sys extension and are copied to …\SYSTEM32\DRIVERS folder in the standard Windows folder on your system. These files are named LucamXXX.sys and LuldrXXX.sys or LwcamXXX.sys and LwldrXXX.sys, or LccamXXX and Lcldr (the XXX represents the 3 digit camera ID number).

Each of the .sys files is called into operation by a custom file with the .inf extension The location of the inf files is controlled by the Windows O/S. They are installed and copied to the …\INF folder in the standard Windows folder on your system. There are up to two of these files for each camera model supported by the software. The names of these files are LucamXXX.inf and LuldrXXX.inf or LwcamXXX.inf and LwldrXXX.inf (the XXX represents the 3 digit camera ID number).

Lumenera uses a custom utility to ensure that the driver files are installed and registered to conform to Windows logo testing. The application is called luihlp.exe and is included with the **driver-only installation packages** described below.

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2.4.2 DirectShow Filters

Several DirectShow (or WDM) related files are installed in the …\SYSTEM folder in the standard Windows folder on your system. All of these files have the .ax extension. These files are stored in the program files folder where the Lumenera software is installed under:

Uninstall_LuCam_Software

When these DirectShow filter files are installed, they are registered with the O/S as residing in a specific folder location. If these files are deleted or moved to a different folder location without being correctly re-registered, then the camera preview and captured images will not display correctly. Their names are:

- Lutf.ax
- Lucustom.ax
- Lustrcfg.ax
- Lgsrcflt.ax (in case of GigE Vision camera)

2.4.3 Application Software

2.4.3.1 USB products

The LuCam Capture application (LuCam.exe) is installed in the directory selected during the installation process. The default location is:

C:\Program Files\Lumenera Corporation\LuCam Software

A shortcut to this application is added to the Start Menu at the location selected during installation. The default location is:

Start→Programs→Lumenera→LuCam→LuCam.exe

2.4.3.2 GigE Vision products

The LgCam Capture application (LgCam.exe) is installed in the directory selected during the installation process. The default location is:

C:\Program Files\Lumenera Corporation\LgCam Software

A shortcut to this application is added to the Start Menu at the location selected during installation. The default location is:

Start→Programs→Lumenera→LgCam→LgCam.exe

2.4.4 Sample Application Executables

Every installation of Lucam software and LgCam software includes a set of executable sample programs to facilitate the evaluation of the camera functionality and performance without the need to develop a custom application. The majority of the Lucam API functions are exercised in these sample executables. Support for these sample programs is not provided. Although they are periodically maintained some of the samples do not function with every Lumenera camera model. Refer to the last chapter of this manual for additional details on the sample executables.

2.4.5 Software Development Kit (SDK)

The LuCam (or LgCam) Capture application source code, and the API libraries are installed in folders called “Sample Applications” and “Lumenera Camera SDK”, which are in the directory selected during the installation process. The default location is “C:\Program Files\Lumenera Corporation\Lumenera Camera SDK”

The source code consists of a complete Microsoft Visual C++ 2005 project. The libraries are also compatible with Visual Basic, Visual Basic.Net and Visual C# .Net. Many additional sample code examples are also available at that location.

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If you wish to purchase the SDK please contact your Lumenera Business Development representative.

2.4.6 Documentation

Documentation consisting of this User's Manual, the API reference manual and the latest available Application Notes and White Papers, is installed in a folder called "Documentation" in the directory selected during the installation process. The default location is:

C:\Program Files\Lumenera Corporation\LuCam Software

C:\Program Files\Lumenera Corporation\LgCam Software

The latest documentation release is included with the download of the current release of LuCam Software and LgCam Software, available on the Support tab of the Lumenera website at:

www.lumenera.com

2.4.7 Driver Only Installation Packages

Included with the SDK are Driver Only installation packages that can be used to install and run the specific camera models on any computer without the need to install the complete software package. In each camera model directory you will find the camera driver and .inf files, the DirectShow files and the API DLL files. Also included in the directory, there is an installation batch file that can be used to install these files or used as a reference for your own installation script and the Microsoft regsvr32.exe application needed to register the Lutf.ax DirectShow filter file. These packages are installed in a folder called "Driver Only Installations" in the directory selected during the installation process. The default location is:

C:\Program Files\Lumenera Corporation\Lumenera Camera SDK\Redist

The files contained in these directories are the same ones used by the camera. If, during your development, a camera file update is required, use the updated files as part of your installation package. You can replace the files in this directory as necessary.

Note: LgCam Software installation does not have a driver only Installation package, therefore the complete installation process is required to ensure all dependencies are installed.

2.5 Using LuCam & LgCam Capture

The LuCam and LgCam Capture applications are simple demonstration programs that are easy to use. The applications are built using the SDK and are a sampling of what the API functions can do; however, it does not incorporate all of the available features of the API. The complete source code for this application is available to those that purchase the SDK.

Only one camera may be controlled by each instance of LuCam (LgCam) Capture, but several instances of the application may be run simultaneously. If more than one camera is detected by the application, a list of available camera serial numbers is presented allowing the user to select the camera they wish to control.

Additionally, the image stream from any one camera can only be provided to a single application. If LuCam (LgCam) Capture or any one of the sample executables is extracting a video stream from the connected camera, it must be stopped before another application will be able to access it.

Launch the LuCam (LgCam) Capture application from the Windows Start menu or from a desktop shortcut icon. LgCam Software will ask to specify the camera interface as it can access both USB and GigE Vision products.

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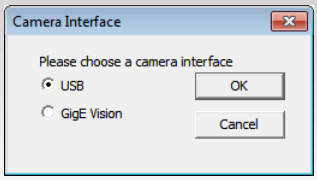

Figure 23: Camera Interface Selection

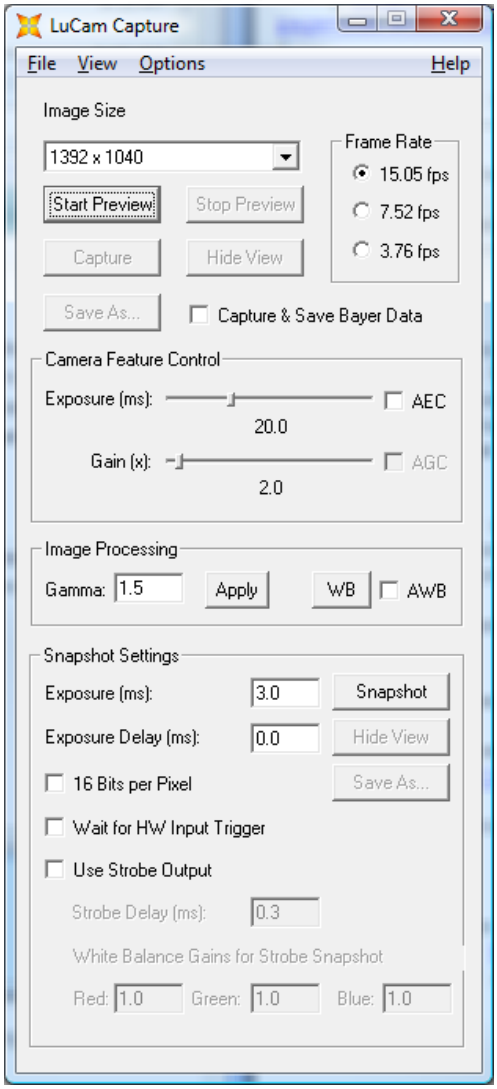

Figure 24: LuCam Capture Main Window

2.5.1 Dialog Items

Video Image Control

The **Image Size** dropdown list provides the available video display resolutions. The Preview must be stopped in order to switch between the various image sizes.

The **Frame Rate** toggle buttons provide the selection of available display frame rates.

Not all cameras have this capability.

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The **Exposure** slider is used to adjust the video exposure time in milliseconds.

The **AEC** toggle button is used to toggle the Automatic Exposure Control (not available for all cameras). When selected, the slider changes to Luminance Target allowing you to select the average brightness you want to maintain as ambient lighting changes. The exposure will be automatically adjusted in an attempt to maintain the average brightness.

The **Gain** slider is used to adjust the global gain of the camera for both video mode and when using the Snapshot mode (described below). The gain value is a multiplicative factor, so a value of 1 means no gain. The value of every pixel in the image is multiplied by the gain value, resulting in an increase in image brightness. When the gain setting is increased, any sensor noise will be amplified, along with the image data, and the picture quality will be degraded. The higher the gain, the more noticeable this is.

The **AGC** toggle button is used to toggle the Automatic Gain Control (not available for all cameras). When selected, the slider changes to Luminance Target allowing you to select the average scene brightness that you want to maintain as ambient lighting changes. The gain will be automatically adjusted in an attempt to maintain the average brightness.

Note: When both AEC and AGC are selected, if an increase in brightness is required, exposure is amplified first until its limit is reached and then gain is adjusted. When a decrease in brightness is required, gain is reduced first until its limit is reached and then exposure is adjusted. This maintains the best image quality.

The **Gamma** value is applied to the image to make it look better on screen. It is used to correct the non-linearity inherent in most CRT monitors. A value of 1 represents no gamma correction. Values less than one will make the image appear darker while a value greater than one will make the image appear brighter. For more information about Gamma and why it is used consult: www.poynton.com/GammaFAQ.html.

The **WB** button adjusts a camera's video preview color gain settings (white balance), based on the overall image, using the Gray World Algorithm. It is done in software by grabbing a video frame, analyzing it, adjusting the color gains and repeating, until the colors in the image are balanced (resulting in an equal amount of Red, Blue and Green in the image). It is best to put a neutral target (e.g. white or grey paper) in front of the camera before performing a color balance. For best results, the image exposure time should be adjusted so that the scene does not contain any saturated pixels (values at maximum brightness).

2.5.2 View Menu Items

Preview Frame Rate will display the average frame rate of the preview window. The average is computed over the whole time span that the display has been actively previewing since the last time Start Preview was pressed.

Show Image Stats displays a window showing the average image intensity for both the preview and snapshots. It takes into consideration the current pixel depth. It also shows the average color pixel value in each mode. When the **"Update for …"** options are selected, the average values are updated with each new image received. Deselecting these options disables the updates.

Move Capture Window to Origin will move the capture window to the top left corner of your desktop.

2.5.3 Options Menu Items

Read/Write Registers pop up a dialog allowing you to read and write the registers of the camera. This is an advanced function and should not be used without the advice of Lumenera's technical support staff.

Light Source provides the option of selecting the ambient lighting source that is being used so that the proper colour correction can be performed by the camera. The visual impact resulting from the light source adjustment varies by camera model, and in some cameras the impact is negligible.

Enable Preview 16-bit Mode will place the camera into 16-bit video preview mode. The video preview window will only display the upper 8-bits but when you hit the Capture button will capture 16-bit video frames. (The number of actual valid data bits per pixel will vary by camera model. Refer to the camera datasheet for the output options available for a specific model).

Monochrome Preview puts the camera into monochrome mode.

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Sharpen Captured Image applies a sharpening algorithm to the image when it's captured (not in the live preview). If an image is currently being displayed, this option will toggle the displayed image between sharpened and unsharpened.

Enable Dual Tap Correction is applicable only for the full frame format camera models where the sensor output can be processed through either a single tap or by using a dual tap mode to improve the data throughput.

Image Averaging averages 5 frames of video together to reduce random image noise when the Capture button is pressed. This option will produce undesirable results when the field of view contains objects in motion.

Image Summing sums 5 frames of video together to produce a brighter image when the Capture button is pressed. This option will produce undesirable results when the field of view contains objects in motion. The resulting image will be 5 times brighter than the current preview images.

Hue/Saturation pops up a dialog that allows you to adjust the hue and saturation of the live preview.

Display Video Properties presents a "canned" dialog generated by the LuCam API that allows you to adjust video properties (Exposure, Gain, Gamma, Brightness, and Contrast).

2.5.4 Buttons and Interface Controls

The **Start Preview** button is used to start the video display to the screen.

The **Stop Preview** button is used to stop the video display to the screen.

Video Frame Capture button is used to grab a frame of video from the video stream and display it on screen.

The **Save As** button is used to save the image to disk in one of the available formats.

The **Hide View** button will close the image display window.

The **Capture & Save Bayer Data** toggle button allows you to view and save the raw Bayer data that comes from the camera, before it is processed into 24-bit RGB data (color cameras only). If a captured image is currently being displayed, this button will toggle the image between raw Bayer and processed 24-bit data.

2.5.5 Snapshot Settings

The **Exposure** value controls the time between the start of image capture and the data read-out for a snapshot, expressed in milliseconds.

The **Exposure Delay** value indicates the time in milliseconds between the receiving the snapshot trigger input and the start of integration on the sensor.

The **Snapshot** button is used to grab an image from the camera using its snapshot mode and half-global or global shutter (if available), and display it on screen (See Shutter Types and Camera Modes sections below for more information about snapshot mode and global shutter).

The **Hide View** button will close the snapshot image display window.

The **Wait for HW Input Trigger** toggle is used to specify that the snapshot should be hardware (HW) triggered using the HW trigger input of the camera's external header. With this option selected, when the Snapshot button is pressed, the software will pause as the camera waits for the HW trigger before returning the image. There is a built-in time-out of 25 seconds after which time if the HW trigger has not occurred, the software will resume operation.

The **Use Strobe Trigger** toggle is used to specify that during the snapshot exposure, the strobe trigger output should be fired.

The **Strobe Delay** value indicates the time in milliseconds between the rising edge of strobe output and the rising edge of the strobe trigger pulse.

The **Save As** button is used to save the snapshot image to disk in one of the available formats.

The **16-Bits per Pixel** toggles the camera between 8 and 16-bit data mode for snapshot capture.

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The **White Balance Gains for Strobe Snapshot** values allow you to set the Red, Green and Blue gains to be used during the snapshot capture. This allows you to white balance according to the strobe lighting that is being used. They are only applied if the Use Strobe Trigger option is selected.

3 Understanding Your Camera

3.6 Shutter Types

Depending on which camera model you have, the following electronic shutter types may or may not be present. Check the table at the end of this section to determine which camera model has which shutter type. These types are selectable for the snapshot mode of the camera (described in a later section).

3.6.1 Rolling Shutter

With a rolling shutter the exposure process begins, whereby rows of pixels in the image sensor start exposing in sequence, starting at the top of the image and proceeding row by row down to the bottom. At some later point in time, the readout process begins, whereby rows of pixels are read out in sequence, starting at the top of the image and proceeding row by row down to the bottom in exactly the same manner and at the same speed as the exposure process.

The time delay between a row starting to expose and a row being read out is the integration time, also known as the exposure time. This integration time can be varied from a single line (start exposure followed by a read out while the next line is exposing) up to a full frame time (last line starts exposing at the bottom of the image before reading starts at the top). In some cases, longer exposures can be obtained by delaying the read out even longer (during which time, the entire array is exposing).

Since the integration process moves through the image over some length of time, skewing of moving objects may become apparent. For example, if a vehicle is moving through the image during capture, light from the top of the vehicle will be integrated at some earlier time than light from the bottom of the vehicle, causing the bottom of the vehicle to appear slanted forward in the direction of motion. For most slow moving objects or still image capture, this motion artefact is not noticeable.

3.6.2 Half Global Shutter

With a half global shutter, the entire image array starts exposing at the same time (globally). At some later point in time, the readout process begins, whereby rows of pixels are read out in sequence, starting at the top of the image and proceeding row by row down to the bottom (exactly like the rolling shutter case).

The time between the global start of integration and the start of readout is defined as the exposure time. However, since during readout of the image the lines are still integrating (like rolling shutter), the actual image exposure differs from the top to the bottom. The difference is the time taken to readout the image and varies for each camera (70 ms is typical). Under bright ambient lighting conditions, the image will appear brighter; the further down the image you go. A half-global shutter is most effective when used under controlled lighting (e.g. strobe flash).

Because integration continues to occur during readout, the skewing motion artefact can still occur.

3.6.3 Global Shutter

With a global shutter, the entire image array starts exposing at the same time (globally). At some later point in time, the entire image array stops exposing at the same time and the image is read out in sequence, starting at the top of the image and proceeding row by row down to the bottom (sometimes odd rows are read out first followed by the even rows). The difference from the other modes is that during readout, the imager is no longer integrating light.

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The time delay between the start of exposure and end of exposure is defined as the exposure time and it represents the total amount of time that the image integrates.

Because all the pixels start exposure at the same time, integrate over the same interval, and stop exposing at the same time, there is no potential for motion artefacts as there is in the other modes.

Table 1: Shutter Types by Camera Model

Camera Model	Rolling Shutter	Half Global Shutter	Global Shutter
Lu070, Lu075, Lw070, Lw075, Lm075	No	No	Yes
Lu080, Lu085, Lm085	No	No	Yes
Lu100, Lu105	Yes	Yes	No
Lw110, Lw115	Yes	No	No
Lu120, Lu125	Yes	No	Yes
Lu130, Lu135, Lw130, Lw135, Lm135	No	No	Yes
Lu160, Lu165, Lw160, Lw165, Lm165	No	No	Yes
Lu170, Lu175, Lu176	Yes	No	No
Lu200, Lu205	Yes	Yes	No
Lw230, Lw235, Lg235	No	No	Yes
Lu270, Lu275	Yes	No	No
Lw290, Lw295	Yes	No	No
Lu330, Lu335	No	No	Yes
Lu370, Lu375	Yes	No	No
Lw560, Lw565,	No	No	Yes
Lw570, Lw575	Yes	Yes	No
Lw620, Lw625	Yes	Yes	No
Lw11050, Lw11056, Lw11057, Lw11058, Lw11059, Lg11059	No	No	Yes
Lw16059	No	No	Yes

3.7 Scanning Mode

Depending on which model of camera you have, the frame integration will be either progressive scan or interlaced. Check the table at the end of this section to determine which camera model has which scan type.

3.7.1 Progressive Scan

In a progressive scan camera, the entire image is integrated (exposed) at one point in time (for global shutters) or line-by-line from top to bottom (for rolling shutters).

3.7.2 Interlaced Scan

In an interlaced scan camera, the entire image is made up of two fields. Each field is made up of the odd lines of the image (odd field) or the even lines of the image (even field). Each field is captured in a progressive manner (using a global shutter), but the exposure for the second field is started after the first one is read out.

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When there is no movement of the object being viewed, you will not see a difference between progressive and interlaced scan images. However, when there is movement of the object, the interlaced scan image will exhibit image artefacts known as the comb effect where the edges of the object look like the teeth of a comb because the object is in a different place for the odd versus the even rows of the image.

Camera Model	Scan Mode
Lu070, Lu075, Lw070, Lw075, Lm075	Progressive
Lu080, Lu085, Lm085	Progressive
Lu100, Lu105	Progressive
Lw110, Lw115	Progressive
Lu120, Lu125	Progressive
Lu130, Lu135, Lw130, Lw135, Lm135	Progressive
Lu160, Lu165, Lw160, Lw165, Lm165	Progressive
Lu170, Lu175, Lu175	Progressive
Lu200, Lu205	Progressive
Lw230, Lw235, Lg235	Progressive
Lu270, Lu275	Progressive
Lw290, Lw295	Progressive
Lu330, Lu335	Interlaced
Lu370, Lu375	Progressive
Lw560, Lw565	Progressive
Lw570, Lw575	Progressive
Lw620, Lw625	Progressive
Lw11050, Lw11056, Lw11057, Lw11058, Lw11059, LG11059	Progressive
Lw16059	Progressive

Table 2: Scan Mode by Camera Model

3.8 Use of Flash or Strobe

A flash or strobe may be used with any camera model and the option is available to provide a programmable trigger signal from the camera to the flash or strobe device to tell it when to fire. However, the type of shutter mode being used will dictate what conditions will be required and how well flash photography will work with the camera.

3.8.1 Flash with Rolling Shutter

The use of a flash with rolling shutter is only feasible for cameras that allow exposures longer than frame read out time (typically about 70 ms). This is because with exposures less than that, only a band across the imager is being exposed at the same point in time and when the flash occurs, it will only illuminate that region of the imager. The flash must be fired at the time when all the pixels of the imager are simultaneously sensitive to light. The strobe signal from the camera is generated at a user selectable delay from that point in time.

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Generally, the ambient lighting should be low enough (i.e. dark) so that during the overall exposure the ambient light will not contribute much to the overall brightness of the image. This is particularly true if the flash is being used to stop the motion of a fast-moving object; otherwise, blurring or skewing may occur. For imaging still objects, this is not as much of a concern. In this case, you only need to ensure that you are not overexposing the object with both a long exposure and a flash.

3.8.2 Flash with Half Global Shutter

The use of a flash or strobe with an imager using a half global shutter is similar to the rolling shutter case. However, because the imager starts at once exposing all the pixels globally, the strobe signal from the camera is generated at a user selectable delay from the start of exposure. It doesn't have to first wait for the rolling shutter to open up all the way, like for rolling shutter mode.

Again, the ambient lighting should be low enough so that during the image read out where the imager is still sensitive, the ambient light will not contribute much to the overall brightness of the image. This is a concern for both moving objects where both blurring and skewing may occur, and still objects where you may have uneven brightness from the top of the image to the bottom (as described in the previous section.)

3.8.3 Flash with Global Shutter

The use of a flash or strobe with a global shutter has no limitations or concerns. The strobe signal from the camera is generated at a user selectable delay from the start of the exposure. Very short, global exposures can be used, so there will be no blurring or skewing or overexposure due to long exposures.

3.9 Camera Modes

The camera has two operating modes: Streaming Video and Snapshot.

3.9.1 Streaming Video

In streaming video mode, image frames are continuously being sent from the camera to the computer where they are available for use. The data is pushed from the camera, with no user intervention required. The rolling shutter is always used in this mode where the camera has a rolling shutter. For cameras that have only a global shutter, this shutter is used for both the video and snapshot capture modes. An output signal is provided on the external I/O header indicating the start of exposure for each video frame and can be used to help synchronize events with the video images. The camera will operate with the fastest frame rates in this mode.

3.9.2 Snapshot (Asynchronous Trigger)

Snapshot mode is used to capture one (or more) individual frames in an asynchronous manner. In this mode, the user must initiate the action to start the image retrieval through either hardware or software.

The software trigger is provided using API function calls. The function call is made causing the snapshot to be taken and a single image is returned.

The hardware input trigger (with a user programmable delay) can be used to initiate the snapshot via the external I/O interface. An API function call is made that puts the camera into this wait for hardware trigger state and then blocks until the hardware trigger is received. Once the trigger is received (or the user selected timeout occurs), the API function returns and passes back the image (or a timeout error code).

Any of the available shutter types can be used with snapshot mode. An output strobe signal with programmable delay can also be synchronized with each snapshot. This is described in more detail in External I/O Interface section.

3.10 Data Format

Data from the camera can be retrieved in one of two pixel formats. These formats represent the bit depth in bits per pixel [bpp]. Either 8 bpp or 16 bpp can be selected. For 16 bpp, not all of the bits are valid data bits. Depending on the camera model, 10, 12 or 14-bits will be valid data, with the remaining 6, 4, or 2-bits always set to zero. A completely

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dark pixel will have all valid bits set to zero and a completely light-saturated pixel will have all valid bits set to one. The valid data bits are stored most significant bit aligned in each word. The words are in Big Endian byte order for Lu series cameras (most significant byte is the first of each byte pair), and Little Endian byte order for Lw and Lg series camera (least significant byte is first of each byte pair). The following tables illustrate this point where the data for the first three pixels (completely light-saturated) of an image are represented.

Pixel	Pixel 1		Pixel 2		Pixel 3	
16-bit Word	Word 1		Word 2		Word 3	
Byte Order	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
	LSB	MSB	LSB	MSB	LSB	MSB
Binary value	11000000	11111111	11000000	11111111	11000000	11111111
Hex value	0xC0	0xFF	0xC0	0xFF	0xC0	0xFF
Decimal value	192	255	192	255	192	255

Table 3: Pixel Data Format for 16 bpp (10 valid data bits) for all Lu series cameras

Pixel	Pixel 1		Pixel 2		Pixel 3	
16-bit Word	Word 1		Word 2		Word 3	
Byte Order	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6
	MSB	LSB	MSB	LSB	MSB	LSB
Binary value	11111111	11000000	11111111	11000000	11111111	11000000
Hex value	0xFF	0xC0	0xFF	0xC0	0xFF	0xC0
Decimal value	255	192	255	192	255	192

Table 4: Pixel Data Format for 16 bpp (10 valid data bits) for all Lw and Lg series cameras

For monochrome cameras, each byte (8bpp) or word (16bpp) represents one complete pixel in the image.

For color cameras, the data arrives from the camera in the raw Bayer format. The imager in a color camera is a monochrome imager that has a Red, Green or Blue color filter over each pixel. The arrangement of this color filter mosaic is called the Bayer format. An example of this can be seen in Figure 2.

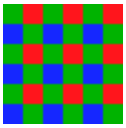

Figure 25: Example of a 6x6 Pixel Area of Color Imager Mosaic Pattern

Each byte (8bpp) or word (16bpp) will be one of the three mosaic colors: Red, Green or Blue. The order of these colors is camera model dependent and can be found in the following Table.

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Table 5: Bayer Data Color Mosaic Order

Camera Model	Mosaic Order			
	Pixel 1 Row 1	Pixel 2 Row 1	Pixel 1 Row 2	Pixel 2 Row 2
Lu070, Lu075, Lw070, Lw075, Lm075	Red	Green 1	Green 1	Blue
Lu080, Lu085	Green 1	Red	Blue	Green 2
Lm085	Blue	Green 1	Green 2	Red
Lu100, Lu105	Blue	Green 1	Green 2	Red
Lw110, Lw115	Green 1	Blue	Red	Green 2
Lu120, Lu125	Green 1	Blue	Red	Green 2
Lu130, Lu135, Lw130, Lw135, Lm135	Red	Green 1	Green 2	Blue
Lu160, Lu165, Lw160, Lw165, Lm165	Red	Green 1	Green 2	Blue
Lu170, Lu175,lu176	Green 1	Red	Blue	Green 2
Lu200, Lu205	Blue	Green 1	Green 2	Red
Lw230, Lw235, Lg235	Red	Green 1	Green 2	Blue
Lu270, Lu275	Green 1	Red	Blue	Green 2
Lw290, Lw295	Green 1	Blue	Red	Green 2
Lu330, Lu335	Red	Green 1	Green 2	Blue
Lu370, Lu375	Green 1	Red	Blue	Green 2
Lw560, Lw565	Red	Green 1	Green 2	Blue
Lw570, Lw575	Green 1	Red	Blue	Green 2
Lw620, Lw625	Green 1	Red	Blue	Green 2
Lw11050, Lw11056, Lw11057, Lw11058, Lw11059, Lg11059	Green 1	Red	Blue	Green 2
Lw16059	Green 1	Red	Blue	Green 2

When using the LuCam Capture application to preview video from a color camera or save images to disk, conversion of the data to standard 24-bit RGB data is done by the software automatically.

When using the API (available with the SDK), you have complete control over this conversion process.

3.11 Subwindowing, Subsampling & Binning

Subwindowing, also known as region of interest (ROI), is the ability of the camera to output a smaller image size (subwindow) than the whole imager array. An imager that supports a maximum resolution of 1280 x 1024 pixels for example, could output a subwindow of 640 x 480 pixels with the subwindow being positioned nearly anywhere inside the 1280 x 1024. The subwindow is actually a smaller field of view than the maximum resolution available. There are limitations on the granularity of the subwindow size and on its position within the whole array. The granularity is 8 pixels.

Subsampling, also known as decimation, is the throwing away of every n^{th} pixel or pixel pair in the image in the X and/or Y directions. For example, an imager with a maximum resolution of 1280 x 1024 could throw away every second pixel in both the X and Y directions and output an image that is 640 x 512 pixels, yet covers the same field of view of the original full resolution. Not all cameras support Subsampling. Those that do may support subsample levels of 2, 4 or 8. Some cameras even allow different Subsampling in the X vs. the Y directions.

Binning is similar to Subsampling, except instead of throwing pixels away, pixel values are combined in some fashion. They can be either summed (to provide greater sensitivity) or averaged (to reduce noise). The resulting resolution would be the same as for Subsampling, but the data from every pixel is used. Several cameras support Binning with binning levels up to 8 by 8.

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3.12 External I/O Interface

3.12.1 Standard LuCam Camera GPI/O Interface Description

For board-level cameras, the External Interface Header can be found in the corner of the PCB next to the silver USB connector. For enclosed cameras, it is found on the side of the camera near the USB connector. It is a male, 2 mm pitch, 16-pin (2 x 8) header. The pin numbering can be seen in Figure 3.

3.12.1.1 Recommended Mating Connectors

The following mating connectors have been tested to work with the cameras. All of them are for 16-pin (2 x 8), 2 mm pitch headers.

- AMP/Tyco P/N 2-111626-5 IDC Ribbon Cable Receptacle
- Molex GC/Waldom P/N 87568-1663 IDC Ribbon Cable Receptacle
- Molex GC/Waldom P/N 87568-1693 IDC Ribbon Cable Receptacle Locking

For above mating connectors, 1 mm, 28 AWG stranded, round conductor flat cable is recommended.

- Molex GC/Waldom 51110-1650 Wire Crimp Receptacle
  - Female Crimp Terminal for above – P/N 50394-8100
- Norcomp P/N 2564-16-01RP2 Vertical Dual Row Receptacle
- Sullins P/N PPWN082AFCN Vertical Dual Row Receptacle

All of these connectors can be purchased from Digi-Key® (www.digikey.com) but other parts suppliers may also carry them.

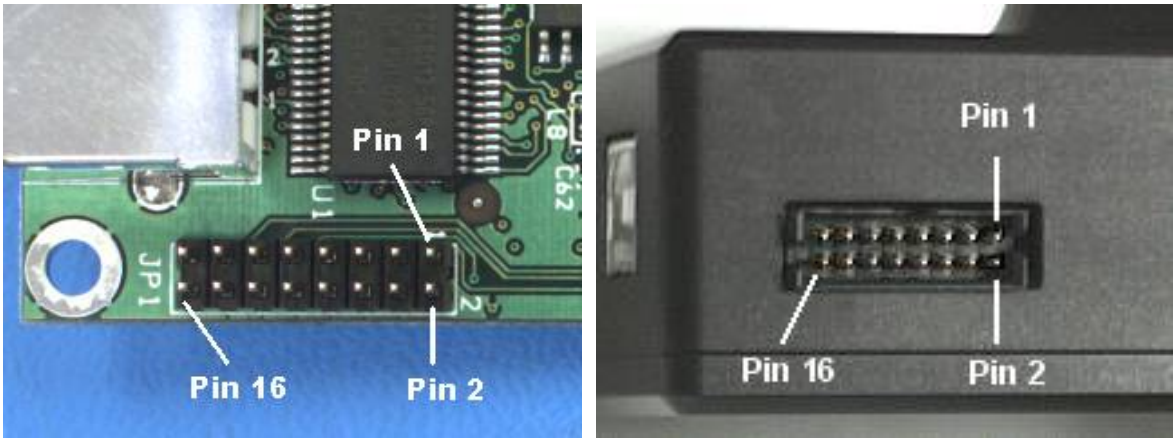

Figure 26: External Header Location and Pin Numbering

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3.12.1.2 Header Pin-out

SIGNAL	PIN #	PIN #	SIGNAL
GPO1 / Strobe Out (AL)	1	2	GND
GPO2 / Strobe Out (AH)	3	4	GND
GPO3	5	6	GND
GPO4 / Video SOF	7	8	GND
GPI1 / Trigger In	9	10	GND
GPI2	11	12	GND
GPI3	13	14	GND
GPI4	15	16	GND or VCC Output (opt.)*

Table 6: Header Pin-out Definition

Note:* Certain camera models can be configured with alternate output for pin 16. In general, the Luxxx products with amber LED will have pin 16 connected to GND and Lw or Lu products with green LED will have this pin connected to VCC. Contact the Technical Assistance Centre for details or confirming the current configuration of this pin.

None of the signals can supply much current. Maximum current draw should be kept to less than 24 mA.

For all GPO pins, the voltage swing is as follows:

- For a LOW value: 0.0 to 0.1 V
- For a HIGH value: 3.0 to 3.3 V

For all GPI pins, the tolerated input voltage swing is as follows:

- For LOW input voltages: 0.0 to 0.5 V
- For HIGH input voltages: 2.0 to 5.0 V

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3.12.2 LuCam Large Format Camera GPI/O Interface Description

For Large Format cameras, the GPI/O port is located on the back of the camera just above the USB and power supply connectors. This port uses a DIN connector from CUI, part number MD-80. It is also available from Digikey, www.digikey.com, Digikey part number CP2080ND. The pin numbering is shown in Figure 27 and Table 7.

Figure 27: Large Format Camera External Header Location and Pin Numbering

3.12.2.1 Header Pin-out

SIGNAL	PIN #
GND	1
GPO1 / Strobe Out (AL)	2
GPO2 / Strobe Out (AH)	3
GPO3	4
GPO4 / Video SOF	5
GPI1 / Trigger In	6
GPI2	7
GPI3	8

Table 7 - Header Pin-out Definition

For all GPO pins, the voltage swing is as follows:

- For a LOW value: 0.0 to 0.1 V
- For a HIGH value: 3.0 to 3.3 V

For all GPI pins, the tolerated input voltage swing is as follows:

- For LOW input voltages: 0.0 to 0.5 V
- For HIGH input voltages: 2.0 to 5.0 V

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3.12.3 GPI/O Descriptions and Signal Definitions for Mini Cameras

For all mini form factor cameras, the external header can be found on the back of the camera near the Mini USB connector. It uses a standard RJ45 connector as shown in Figure 28.

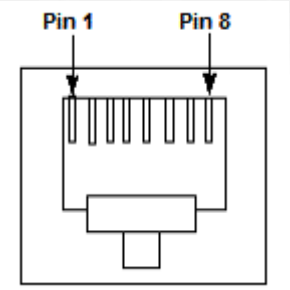

Figure 28: Mini Camera External Header Location and Pin Numbering.

A sample configuration for trigger and strobe using this connector is shown in Figure

3.12.3.1 Header Pin-out

Table 8: Header Pin-out Definition

Pin	Function	Signal
1	optically-isolated output, negative lead	GPO1 (negative lead)
2	optically-isolated output, positive lead	GPO1 (positive lead)
3	optically-isolated input, negative lead	GPI1 (negative lead)
4	bi-directional input/output 0	GPO/GPI2
5	ground	ground reference for GPIO2-4
6	optically-isolated input, positive lead	GPI1 (positive lead)
7	bi-directional input/output 2	GPO/GPI4
8	bi-directional input/output 1	GPO/GPI3

3.12.3.2 GPI/O Connector Description

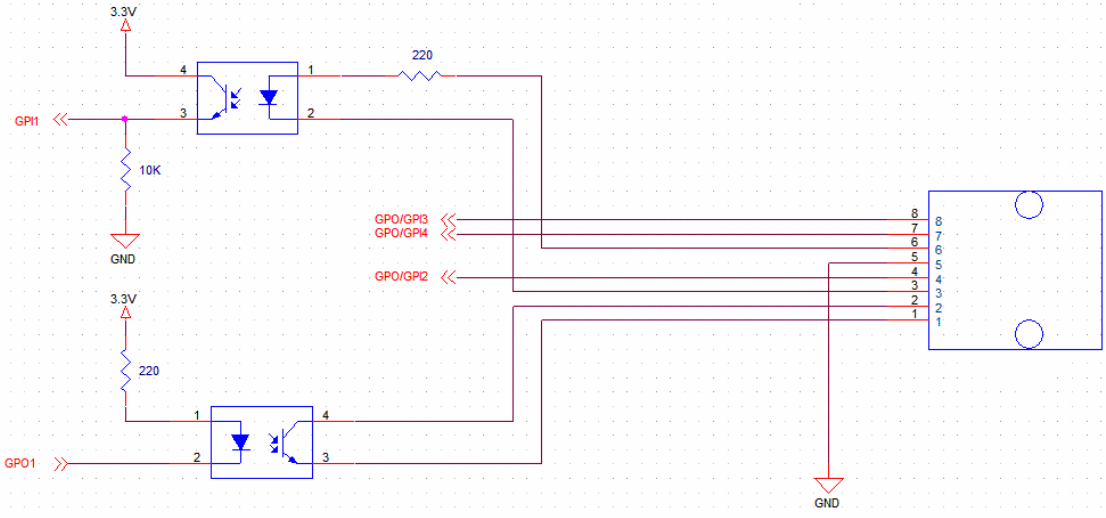

Figure 29: Mini Camera GPIO Connector Circuit Diagram

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Optically-Isolated Input

These input pins are designed for 3.3 to 5 V nominal input (12 V absolute maximum). Greater input voltages are supported with use of external resistor. Current flowing between pins 6 and 3 must not exceed 50 mA maximum, and should nominally be 20 mA. The internal resistor value on these pins is 220Ω.

Therefore, Vinput = (0.02 A)*(220 Ω + Rexternal)

Optically-Isolated Output

These outputs require an external resistor and current biasing for use. Connect pin 2 to a supply voltage, and place a resistor between pin 1 and Ground. Measure the current output at pin 1. The current flowing between pins 2 and 1 must not exceed 50 mA, and should nominally be 20 mA.

For example, if biasing with a 5 V supply (output referenced to 5 V), use a 220Ω series resistor. For a 12 V supply, use 560Ω.

Bi-directional Input/Outputs

The direction of these inputs can be controlled through software. The input pins are 3.3 V or 5 V nominal. The output pins are 3.3 V nominal.

3.12.3.3 GPI/O Input and Output Port Tolerances

Optically-isolated Input:

- Nominal voltage: 5 V
- Maximum voltage: 12 V
- Threshold voltage for input to be considered high is approximately 0.55 V

Note: The maximum can be increased with an external resistor, as described in Section 3.12.3.2 .

Optically-isolated Output:

- Output requires an external resistor
- Maximum voltage depends on the external resistor value

Note: Maximum current that can be provided from the output port is 50 mA.

Bi-directional I/O:

- Nominal voltage can be either 3.3 V or 5 V
- Maximum voltage: 5 V
- Minimum threshold for input to be considered high is approximately 2 V
- Maximum threshold for an input to be considered low is approximately 0.8 V

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3.12.4 Gigabit Cameras GPI/O's Interface Description

For Lg cameras, the external header can be found on the back of the camera near the GigE connector.

Figure 30: Lg Camera External Header Location and Pin Numbering

3.12.4.1 Recommended Mating Connectors

The HR10A-10P-12S connector can be use as mating connectors for the HR10A-10R-12 connector.

All of these connectors can be purchased from Digi-Key® (www.digikey.com) but other parts suppliers may also carry them.

3.12.4.2 Header Pin-out

Pin	Default configuration
1	NC
2	GND
3	GPI1
4	GPO1
5	GND
6	GPI2
7	GPO2
8	GND
9	GPIO1
10	GPIO2
11	NC
12	GND

Table 9: Header Pin-out Definition

3.12.4.3 GPI/O Connector Description

For all GPO pins, the voltage swing is as follows:

- For a LOW value: 0.0 to 0.1 V
- For a HIGH value: 3.0 to 3.3 V

For all GPI pins, the tolerated input voltage swing is as follows:

- For LOW input voltages: 0.0 to 0.5 V
- For HIGH input voltages: 2.0 to 5.0 V

3.12.5 Signal Definitions for All Cameras

GPO1 / Strobe Out: This signal serves double duty and is also used to provide an ACTIVE LOW, 5.5 ms pulse (suitable for triggering a strobe unit) when any of the Take Snapshot API functions are used with the useStrobe option

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enabled. This strobe pulse can be delayed with respect to the start of frame exposure by a user selectable amount (see the Lumenera API Reference Manual for further details).

This signal can be toggled using the LucamGpioWrite() function.

GPO2 / Strobe Out: This signal serves double duty and is also used to provide an ACTIVE HIGH, 5.5 ms pulse (suitable for triggering a strobe unit) when any of the Take Snapshot API functions are used with the useStrobe option enabled. This strobe pulse can be delayed with respect to the start of frame exposure by a user selectable amount (see the Lumenera API Reference Manual for further details).

This signal can be toggled using the LucamGpioWrite() function.

GPO3: This signal can be toggled using the LucamGpioWrite() function.

GPO4 / Video SOF*: This signal serves double duty and is also used to provide an ACTIVE HIGH, 85 **µ**s pulse each time a frame is output in video mode for most of the cameras. For some of the CCD based cameras*, the duration of the pulse reflects the exposure set in the camera and the falling edge represents the Start of Readout of the sensor. The LucamGpoSelect() API function is used to enable/disable the Video SOF signal.

This signal can be toggled using the LucamGpioWrite() function.

* Currently supported on the Lw070, Lw130, Lw160 and Lw230-based cameras.

GPI1 / Trigger In: This signal serves double duty and is also used to receive an ACTIVE HIGH, LVTTL input (Vin min = 0 V, Vin max = 3.3 V) pulse which will trigger the taking of a snapshot, when any of the Take Snapshot API functions are used with the useHwTrigger option enabled. The active high pulse must have a minimum width of 0.5 **µ**s. There is no maximum limit to the trigger pulse width.

This signal is floating and **MUST** be driven at all times when being used. The signal status can be obtained by using the LucamGpioRead() function.

GPI2: This signal is floating and MUST be driven at all times when being used. The signal status can be obtained by using the LucamGpioRead()function.

GPI3: This signal is floating and MUST be driven at all times when being used. The signal status can be obtained by using the LucamGpioRead() function.

GPI4: This signal is floating and MUST be driven at all times when being used. The signal status can be obtained by using the LucamGpioRead() function.

VCC Output: This optional feature allows the camera to output a 3.3 V DC signal on Pin 16. The camera can source up to 50 mA of current from this pin. This feature is only available on Lw-based cameras that have been ordered with this option available. This feature is not available on existing Lu-based cameras. The large format cameras, mini cameras and GigE Vision cameras do not have this signal available on the external I/O connector.

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3.12.6 USB Tether Connector

Some board level models do have a connector to enable to use a 5 pins flat connector (Figure 31) for the USB connection. For the signal voltages, please refer to USB 2.0 specifications. **Table 10** describes the connector signal configuration.

Figure 31: USB Tether connector

PIN	Function
1	VBUS
2	DM
3	DP
4	GND
5	SHIELD GND

Table 10: USB Tether Connector Pin-out Description

3.12.7 Taking a Single-Frame Snapshot with the Camera External I/O Interface

The Lumenera LuCam API makes use of several of the External Interface Header pins automatically; when the Take Snapshot related functions (those that use the LUCAM_SNAPSHOT structure) are called with certain options (see the LuCam API documentation for more details). The LUCAM_SNAPSHOT structure allows the setting of the following parameters that control the taking of a snapshot and the timing of triggers:

Trigger Mode (useHwTrigger): There are two types of snapshot triggering, hardware and software. When enabled, the snapshot will be triggered when the trigger input signal is detected after a Take Snapshot API is called (the API blocks until it times out or until the trigger occurs and the frame of data is returned). When disabled, the API function itself triggers the snapshot and returns the frame of data. The hardware trigger is expected on Pin 9 of the External Interface Header as described above. The software trigger is initiated from within the API Take Snapshot functions (for more details see the API documentation.)

Trigger Delay (exposureDelay): A delay in milliseconds from the trigger (hardware or software) to the start of frame exposure can be set.

Strobe Mode (useStrobe): In concert with either triggering mode, a user may also trigger an external strobe light synchronized to the frame exposure. When this parameter is enabled, the strobe signal pulse will be initiated on Pins 1 and 3 as described above. In this case, a strobe delay should be defined.

Strobe Delay (strobeDelay): A delay in milliseconds from the trigger (hardware or software) to the strobe pulse (rising edge for ACTIVE HIGH, falling edge for ACTIVE LOW) can be set.

Exposure Time (exposure): The length of time in milliseconds to expose the image before readout begins.

Refer to the Figure 32, Figure 33 and Figure 34 below for sample diagrams that illustrate how camera trigger circuits and output strobe circuits can be configured.

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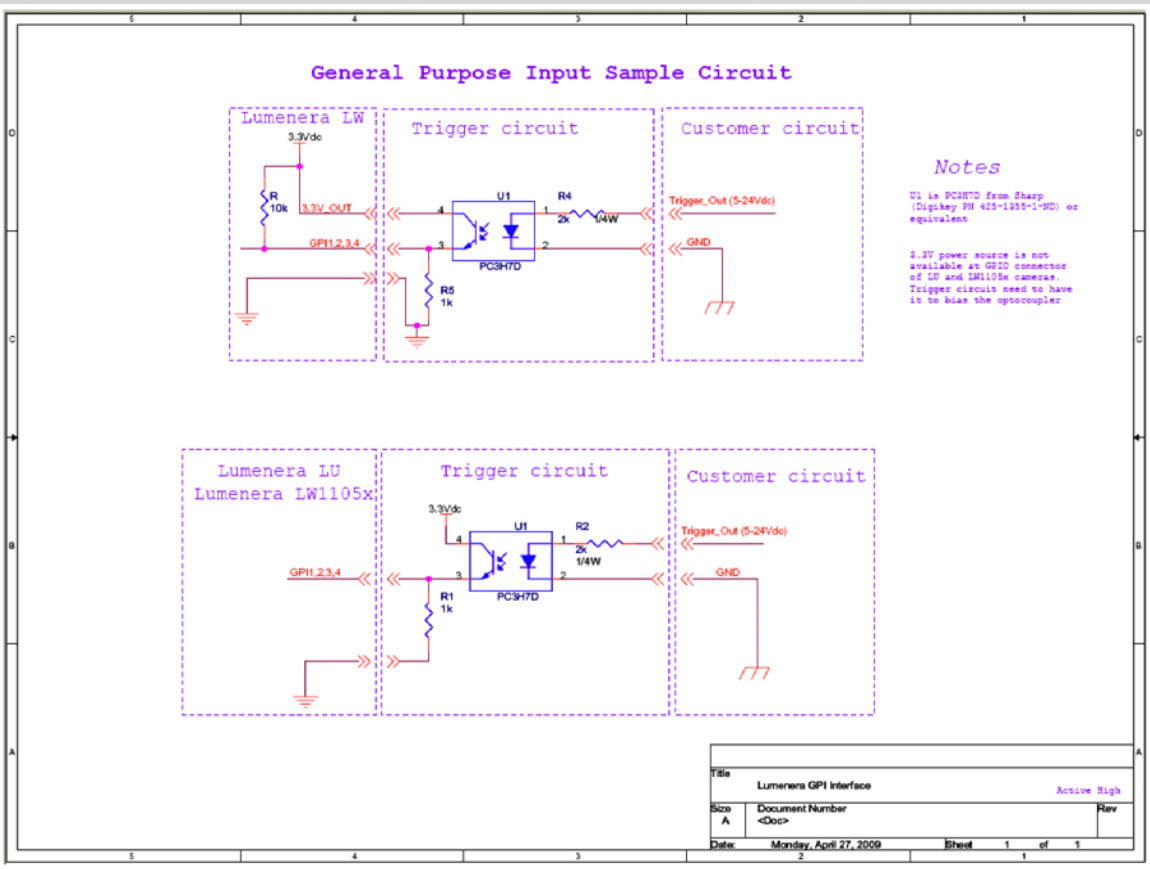

Figure 32: General Purpose Input Sample Circuit Diagram

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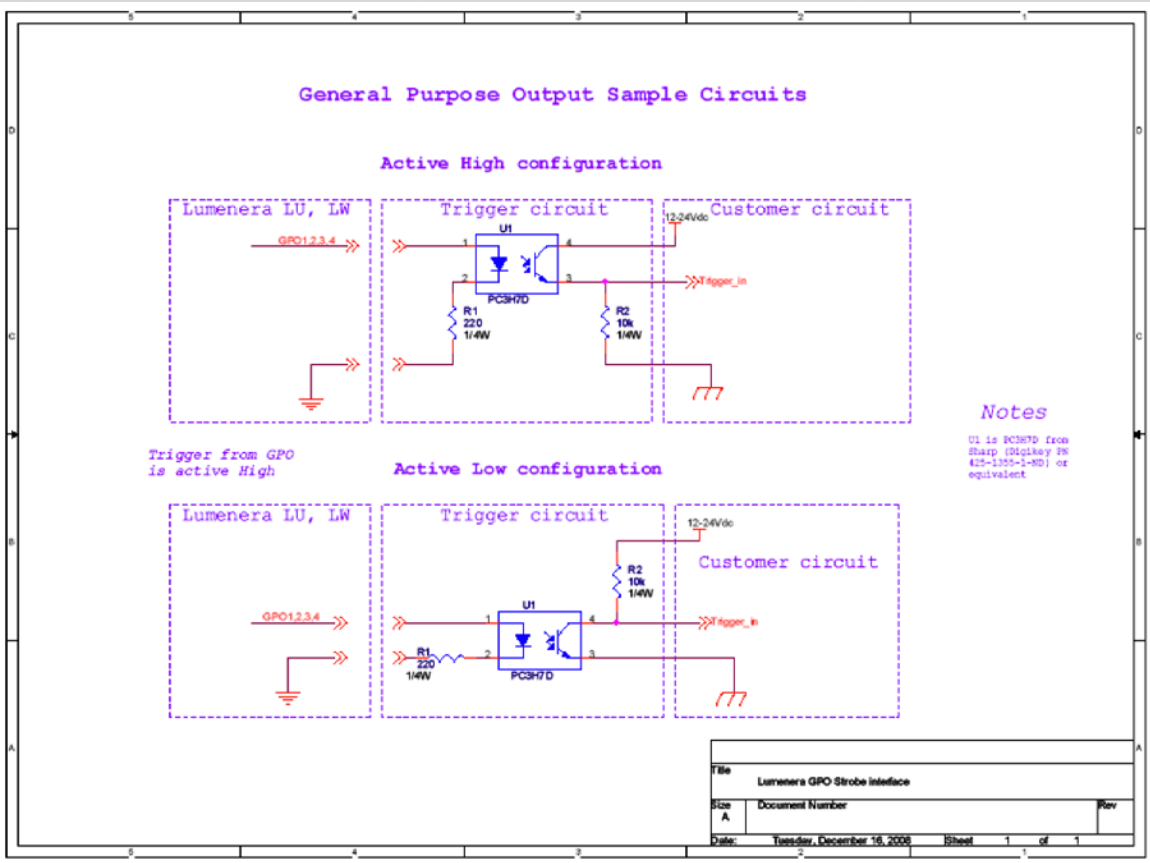

Figure 33: General Purpose Output Sample Circuit Diagram

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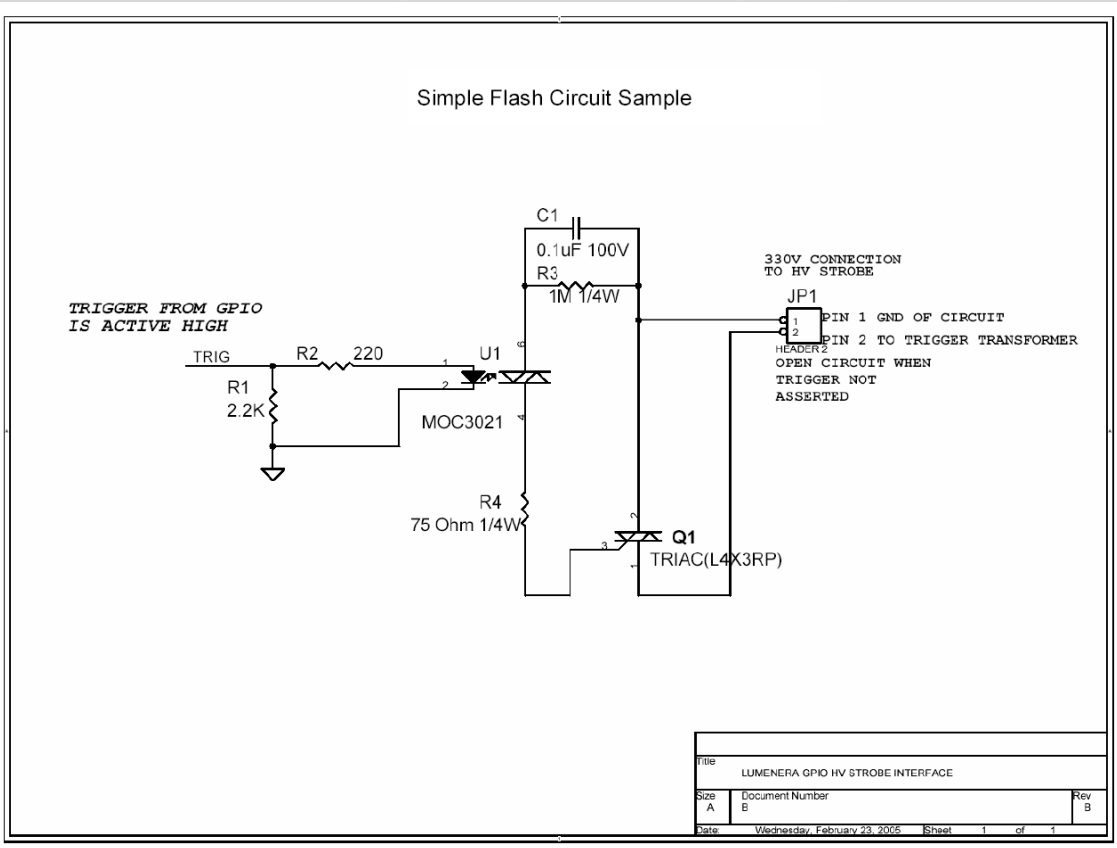

Figure 34: Simple Flash Sample Circuit Diagram

3.13 External Power

Most camera models are powered exclusively via the USB cable, which nominally supplies 5 Volts. Large format camera models (eg: Lw11059, Lw16059) require an external 12 V power adapter. The Lu176 model requires a 9 V

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power adapter to charge the flash. A power adapter can also be used to power the camera, in cases where the USB cable does not supply power (e.g. from a Laptop computer or non-powered USB hub.)

The GigE Vision camera models require an external 12 V power adapter at all time.

The appropriate external power adapter for your camera can be purchase directly from Lumenera. The Lumenera power adapter part number for your camera can be found under Lumenera website (www.lumenera.com) or you can contact Lumenera Technical Assistance team (support@lumenera.com). The usage of a universal power adapter is also possible and this component must adhere to the following specifications:

Lu series cameras:

1. 6 Volts DC Regulated
2. 1000 mA Minimum Current rating
3. 2.1 mm Tip
4. Center Positive (+)

Lw series cameras:

1. 5 Volts DC Regulated
2. 500 mA Minimum Current Rating
3. 2.1 mm Tip
4. Center Positive (+)

Exception: Lw110 uses a 6 V DC power adapter when USB power is insufficient.

Large format cameras (LW1105x, LW62x)

1. 12 Volts DC Regulated
2. 2 A Minimum Current Rating
3. 2.1 mm Tip
4. Center Positive (+)

Lg series cameras

1. 12 Volts DC Regulated
2. 2 A Minimum Current Rating
3. 2.1 mm Tip
4. Center Positive (+)

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3.14 Lens Mount

By default, the camera is equipped with an industry standard C-mount lens mount. A CS-mount may be ordered as an option.

The large format camera models accept the equivalent SLR lenses for Canon, Nikon F-mount, Pentax K-mount, based on the specific camera model ID.

Lw11059, Lw16059, Lm11059, Lg11059 – Canon

Lw11058 – Pentax

Lw11057 – Nikon

3.15 Camera IDs

Each camera has a unique camera ID that can be accessed through the LuCam API interface. This ID can be useful to set specific camera functions in your software. The LuCam Capture application displays this ID in its About dialog box. Below is a list of current camera IDs.

Table 11 List of Camera Identification Number

Camera Model	ID
Lu070M, Lu075M, Lu070C, Lu075C	0x08C
Lw070M, Lw075M, Lw070C, Lw075C	0x18C
Lm075M, Lm075C	0x28C
Lu080M, Lu085M, Lu080C, Lu085C	0x085
Lm085M, Lm085C	0x284
Lu100M, Lu105M, Lu100C, Lu105C	0x092
Lw110M, Lw115M, Lw110C, Lw115C	0x49F
Lu120M, Lu125M, Lu120C, Lu125C	0x096
Lu130M, Lu135M, Lu130C, Lu135C	0x09A
Lw130M, Lw135M, Lw130C, Lw135C	0x19A
Lm135M, Lm135C	0x29A
Lu160M, Lu165M, Lu160C, Lu165C	0x08A
Lw160M, Lw165M, Lw160C, Lw165C	0x18A
Lm165M, Lm165C	0x28A
Lu170M, Lu175M, Lu170C, Lu175C	0x09E
Lu176C	0x082
Lu200C, Lu205C	0x097
Lw230M, Lw235M, Lw230C, Lw235C	0x180
Lu270C, Lu275C	0x08D
Lw290C, Lw295C	0x1CD
Lu330C, Lu335C	0x09B
Lw330C, Lw335C	0x19B
Lu370C, Lu375C	0x08B
Lw560M, Lw565M, Lw560C, Lw565C	0x1CE
Lw570M, Lw575M, Lw570C, Lw575C	0x1C5
Lw620M, Lw625M, Lw620C, Lw625C	0x186
Lw11050M, Lw11056M, Lw11057M, Lw11058M, Lw11059M Lw11050C, Lw11056C, Lw11057C, Lw11058C, Lw11059C	0x1C8
Lw16059	0x1C9
Lg235C, Lg235M	0x40080
Lg11059	0x400C8

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4 SDK Sample Applications

4.16 General Overview

Sample applications are included with every installation of the LuCam software and LgCam Software. The purpose of these sample programs is to showcase many of the camera features and capabilities as part of an evaluation of the product.

The full source code for each sample application is included with the purchase and installation of the SDK package. These sample applications demonstrate the use of the majority of the LuCam API functions. Most of the samples are provided as a coding reference for customers using the LuCam API functions to develop camera applications.

All of the sample applications are provided to use as-is in the following default installation directory:

C:\Program Files\Lumenera Corporation\LuCam Software\SDK\Executables

The supplied sample applications are listed by name in the table below. Additional descriptions and screen shots showing the application sample dialogs for many of these samples can be found below the table.

AutoLens.exe	AutoProperties.exe	AVISample.exe
BlankCamera.exe	Callback.exe	CapturetoFile.exe
ClickCrop.exe	DirectShow Callback.exe	DirectX.exe
DirectXSnapshot.exe	DualSlope.exe	DualSnapshot.exe
DX Control.exe	EnumFrameRates.exe	FastSyncSnaps.exe
Flipping.exe	FrameRate.exe	Get16BitInfo.exe
GetRanges.exe	GPIEvent.exe	GPIOTest.exe
HiDySample.exe	Histogram.exe	HwTrigCount.exe
INFINITYTest.exe	MonoChechk.exe	PermStorage.exe
PictureFlip.exe	ResetAndFF.exe	ScrollingPreview.exe
Snapshot.exe	Threshold.exe	WinConsole.exe

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4.17 Description of Sample Applications

4.17.1 AutoLens Sample Application

This Visual C++.Net sample can be used to control auto-iris and focus capabilities of a lens used with the Lw11059, Lg11059 and Lw16059 based cameras.

4.17.1.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[x] GigE Vision Products	[ ] Matlab Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

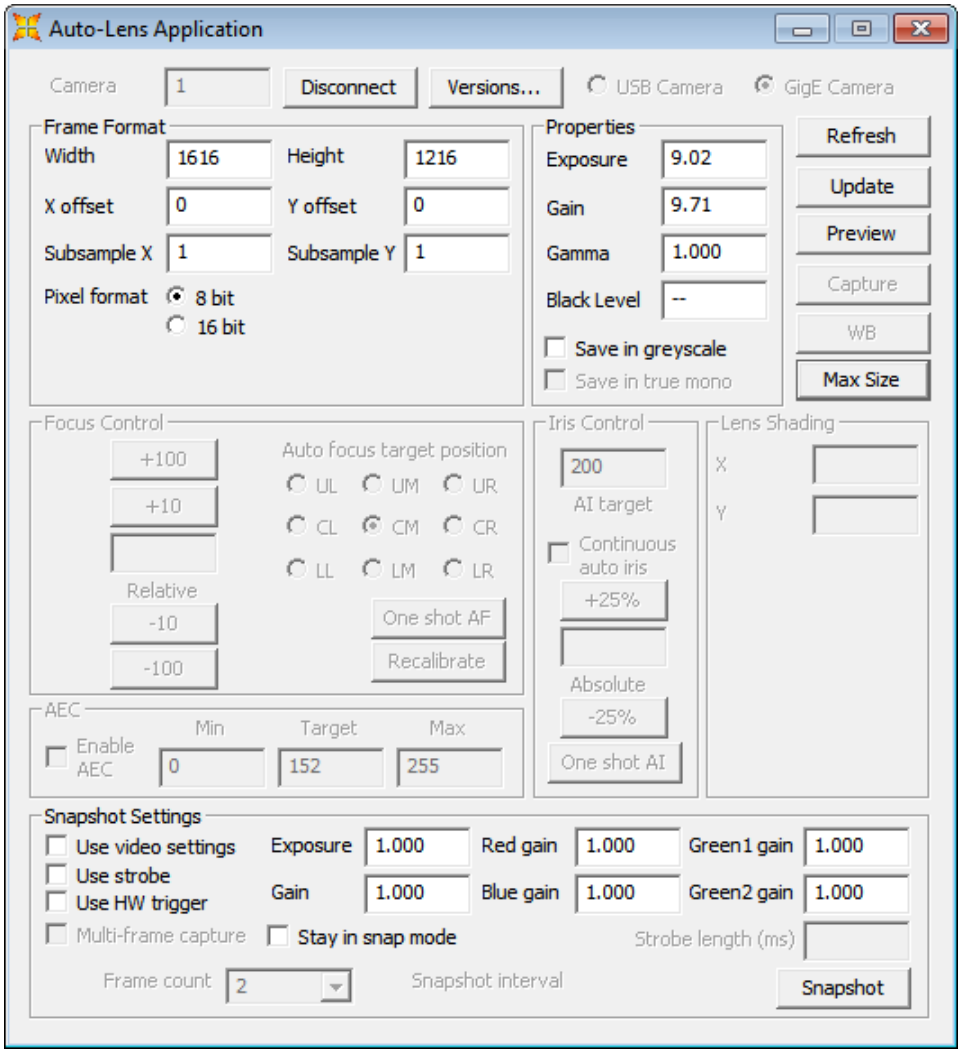

Figure 35: AutoLens Application

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4.17.2 Auto Properties Sample Application

This Visual C++.Net sample code demonstrates how to set camera auto properties.

4.17.2.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] Matlab Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.3 AVI Sample Application

This Visual C++.Net sample can be used to capture and playback an AVI file.

4.17.3.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

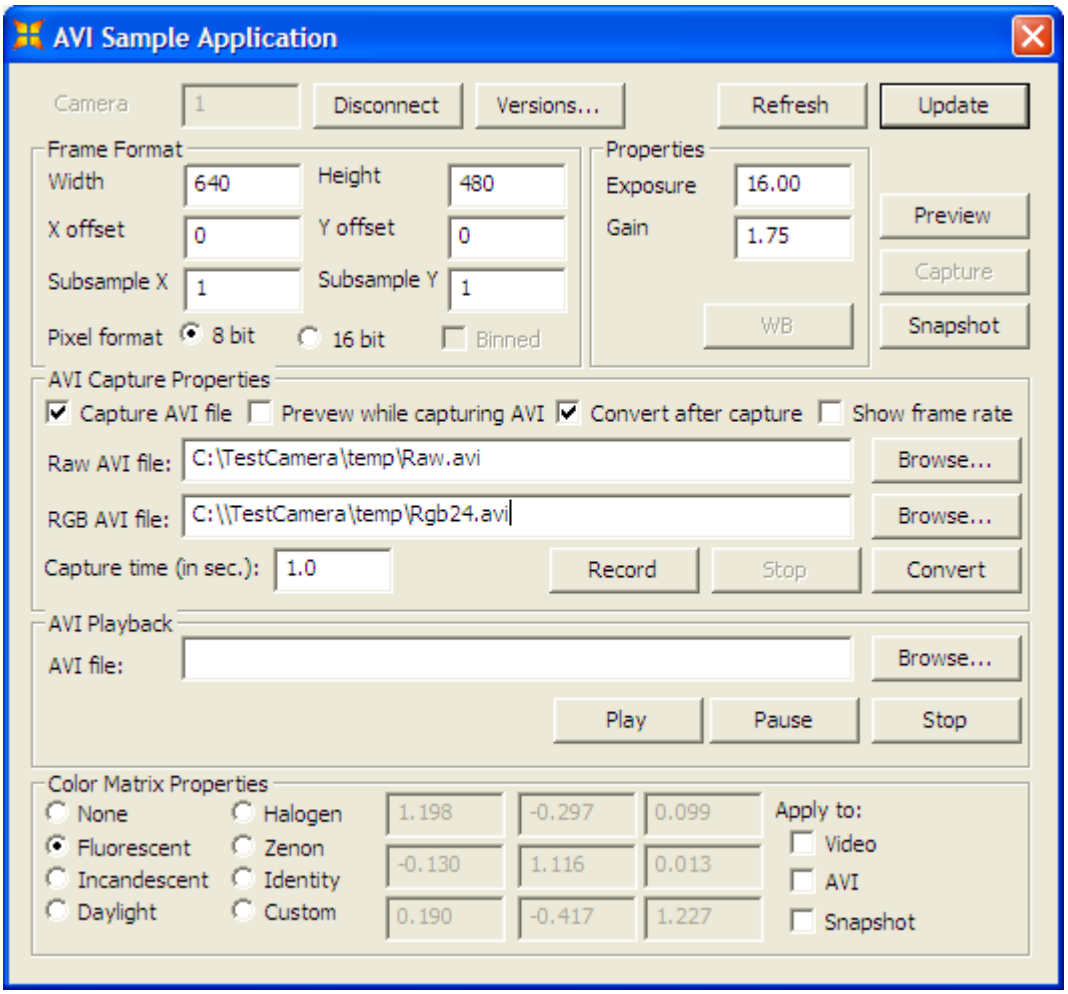

Figure 36: AVI Sample Application

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4.17.4 Blank Camera Sample Application

This Visual C++.Net sample code is generic on connecting and controlling the camera.

4.17.4.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[x] GigE Vision Products	[ ] MATLAB Sample	[x] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

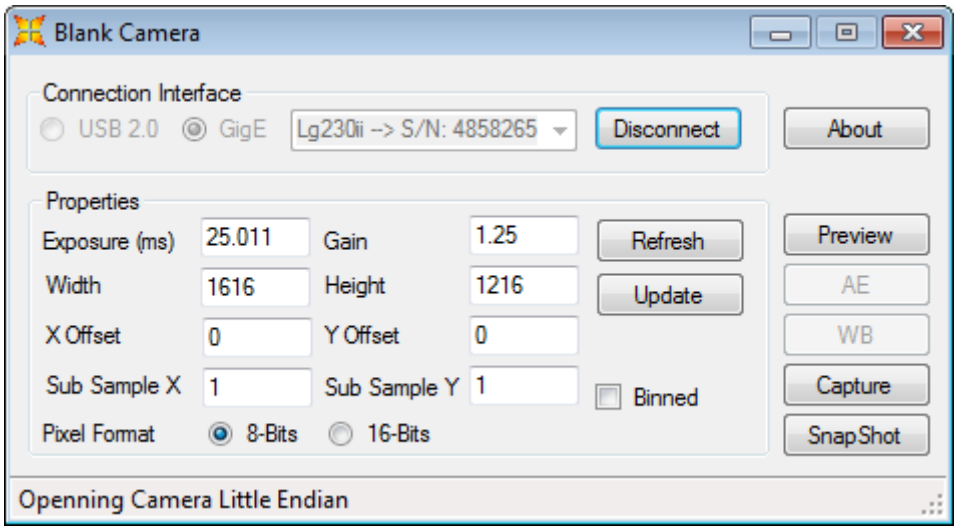

Figure 37: Blank Camera Application

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4.17.5 Callback Sample Application

This Visual C++ .Net sample can be used to measure the number of frames captured by the computer for both video frames and snapshot frames, and calculate the capture time of each frame and the average frame rate. The code demonstrates how to create a Callback function for both a preview and snapshot Callback.

4.17.5.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

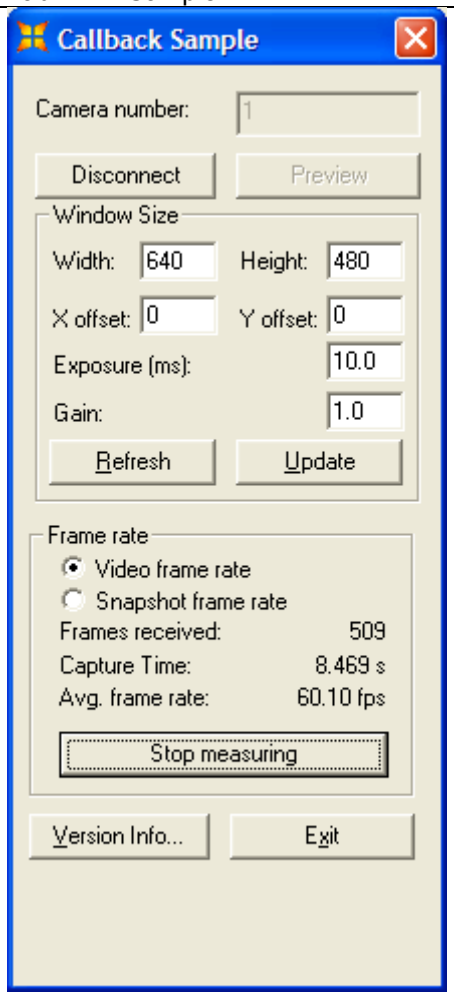

Figure 38: Callback Application

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4.17.6 CaptureToFile Sample Application

This Visual C++ .Net sample can be used to capture and save images, and to convert the pixel data into ASCII text and saves this data to a text file.

4.17.6.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

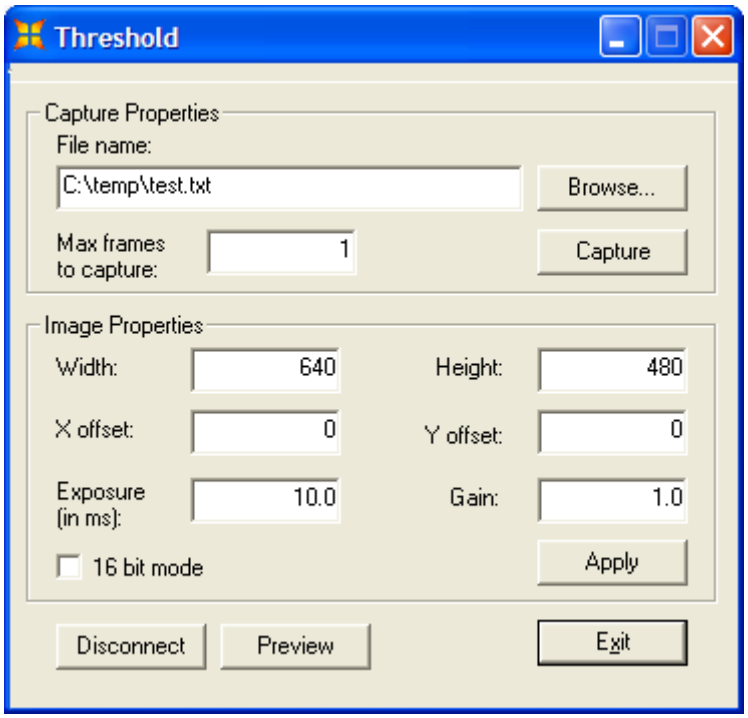

Figure 39: CaptureToFile Application

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4.17.7 ClickCrop Sample Application

This Visual C++ .Net sample code demonstrates how to use the Callback function to apply an overlay to the video stream. Either a rectangle or elliptical overlay can be selected and placed onto the preview window. The size of the shapes can also be defined. The position can be selected by clicking with the mouse on a location in the preview window. A snapshot can be taken based on the full field of view or just the overlay area.

4.17.7.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

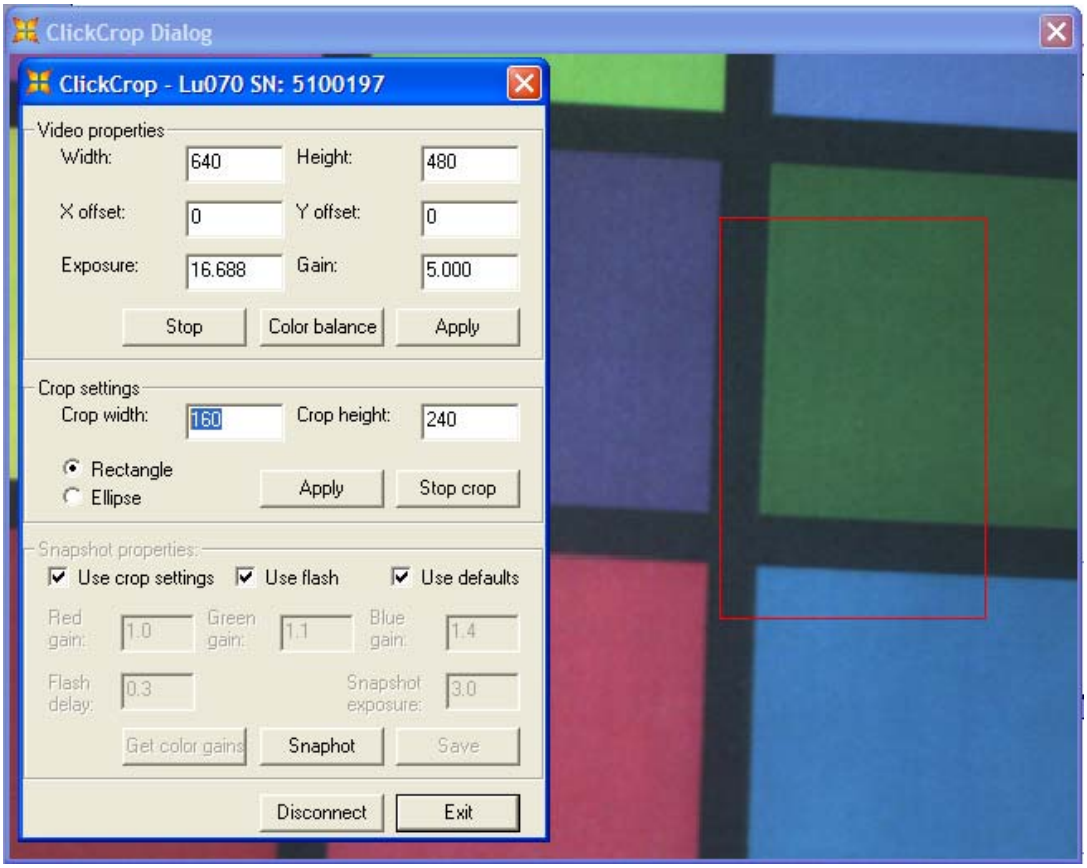

Figure 40: ClickCrop Application

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4.17.8 DirectShow Callback Sample Application

This Visual C++ .Net sample code demonstrates how to setup a Callback function using the camera's DirectX interface. The Callback function applies a gamma function to the video data through a LUT (Look Up Table).

4.17.8.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.9 DirectX Sample Application

This Visual C++.Net sample code demonstrates how to access the camera through its DirectX interface. It provides controls to start and stop the video stream, preview the video data and control the demosaicing method, control the exposure, gamma, contrast and brightness values. It also demonstrates how to access the permanent buffer storage on the camera.

4.17.9.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

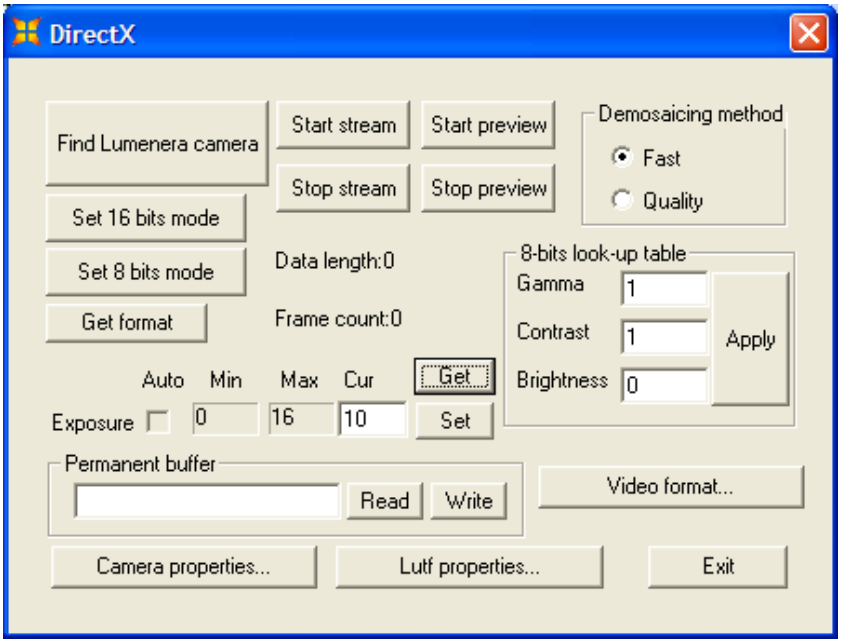

Figure 41: DirectX Application

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4.17.10 DirectX Snapshot Sample Application

This Visual C++ .Net sample code demonstrates how to acquire a snapshot through the DirectX interface; change the exposure and gain values; use the strobe output and toggle the trigger input between a SW trigger and HW trigger.

4.17.10.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.11 Dual Slope Sample Application

This Visual C++ .Net sample code demonstrates how to use the dual slope feature of the Lu120 and Lw620 cameras.

4.17.11.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

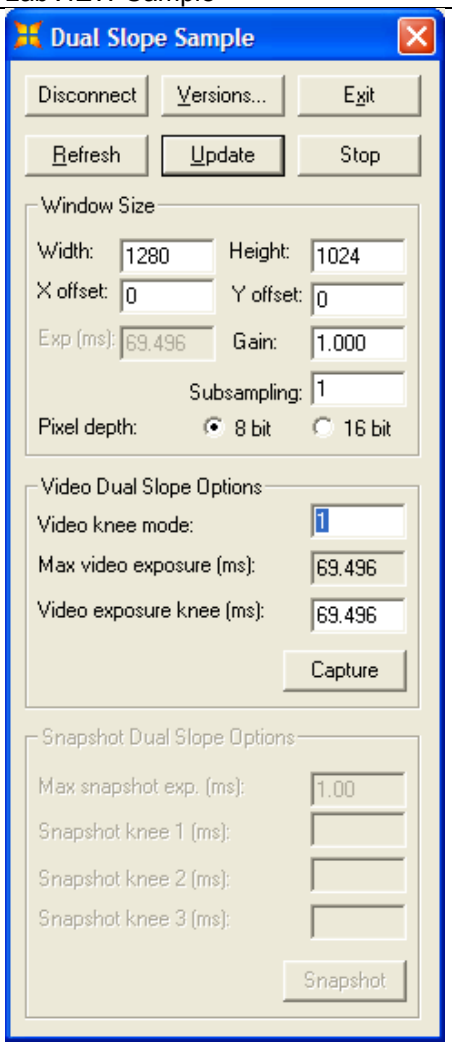

Figure 42: Dual Slope Application

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4.17.12 Dual Snapshot Application

This Visual VB .Net sample code is a simple application to take snapshot with two cameras connected. It gives the ability to setup all parameters to enable the acquisition of a single snapshot or take synchronous snapshot or take snapshot in threads mode.

4.17.12.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[ ] C++ Base Sample
[x] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[x] VB Base Sample

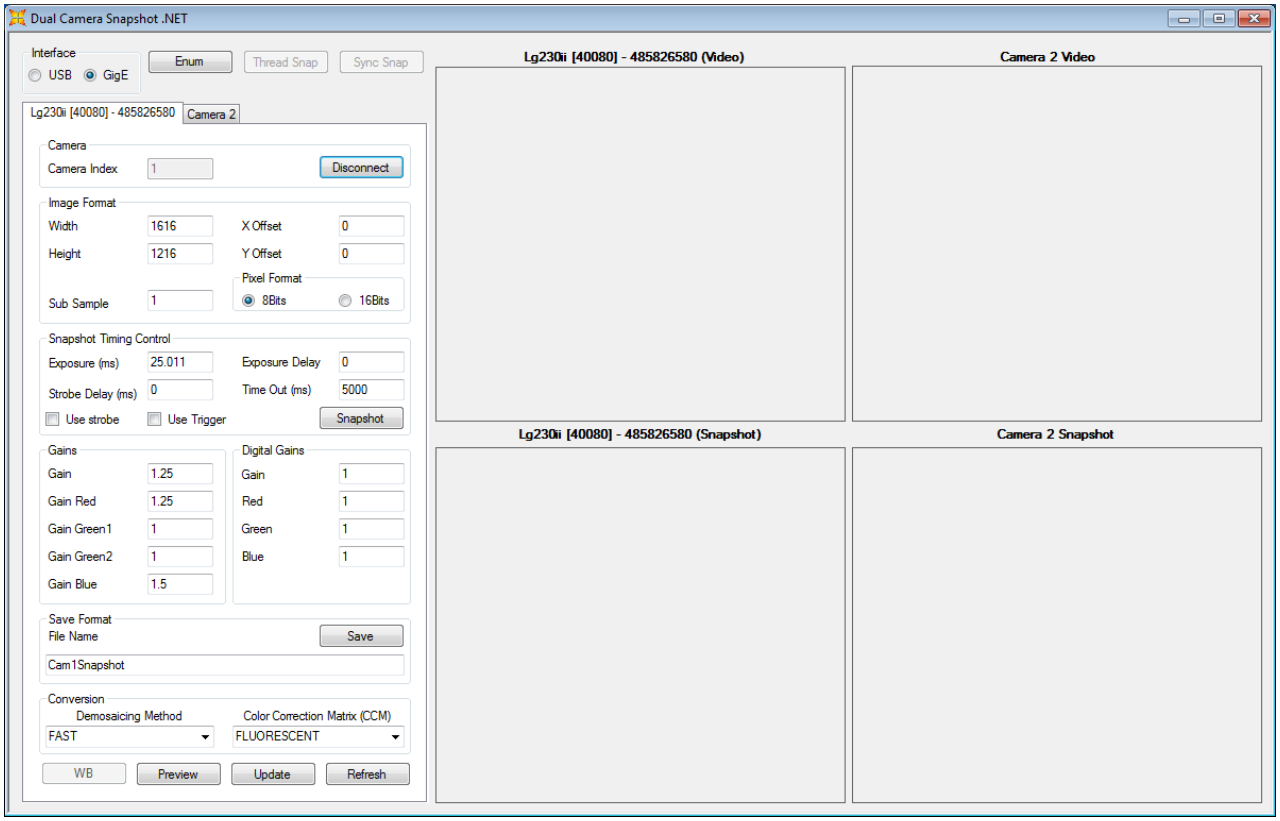

Figure 43: Dual Camera Snapshot Application

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4.17.13 DX Control Sample Application

This Visual C++.Net sample code is a console based application that uses the DirectX interface of the camera.

4.17.13.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.14 Enum Frame Rates Sample Application

This Visual C++.Net sample is a console based application that lists the available frames rates for the camera.

4.17.14.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.15 Fast Synch Snaps Sample Application

This Visual C++ .Net sample code demonstrates how to do fast synchronous snapshots from multiple cameras.

4.17.15.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.16 Flipping Sample Application

This Visual C++ .Net sample can be used to flip and mirror the video preview.

4.17.16.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

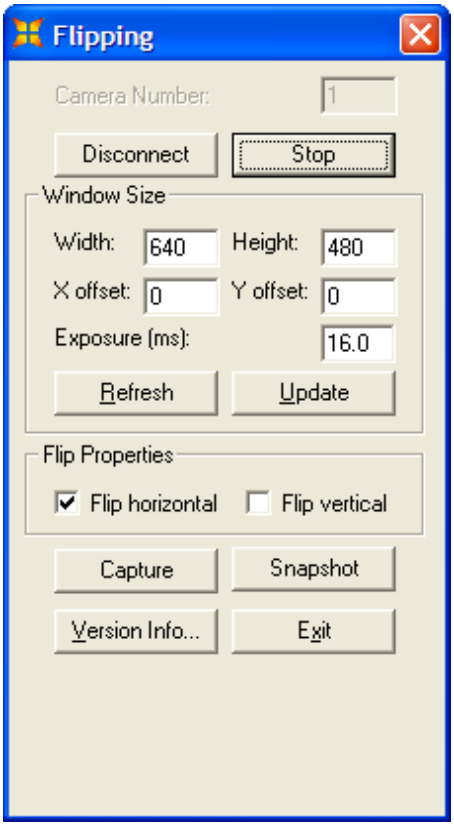

Figure 44: Flipping Application

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4.17.17 Frame Rate Sample Application

This Visual C++ .Net sample can be used to read the available frame rates.

4.17.17.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

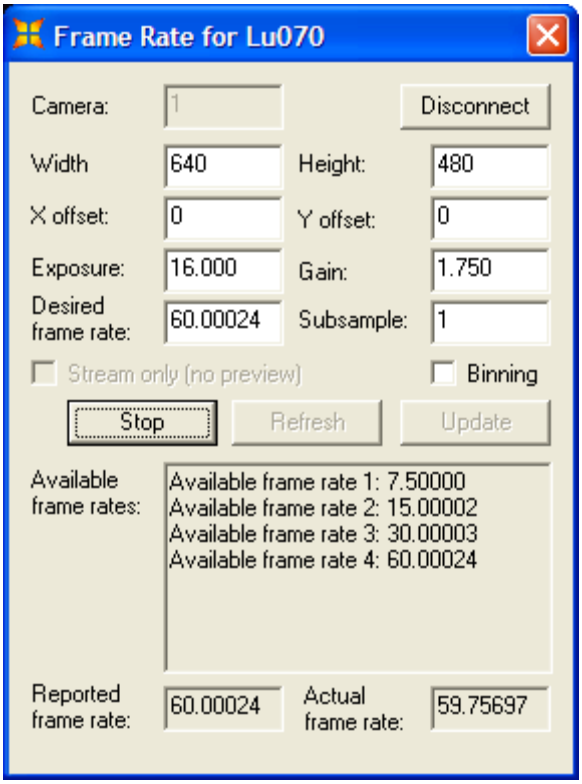

Figure 45 Frame Rate Application

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4.17.18 Get 16-bit Info Sample Application

This sample Visual C++.Net application is a console-based application that provides information on the 16-bit mode of the camera such as its bit depth and whether the output data is structured as big Endian or little Endian.

4.17.18.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

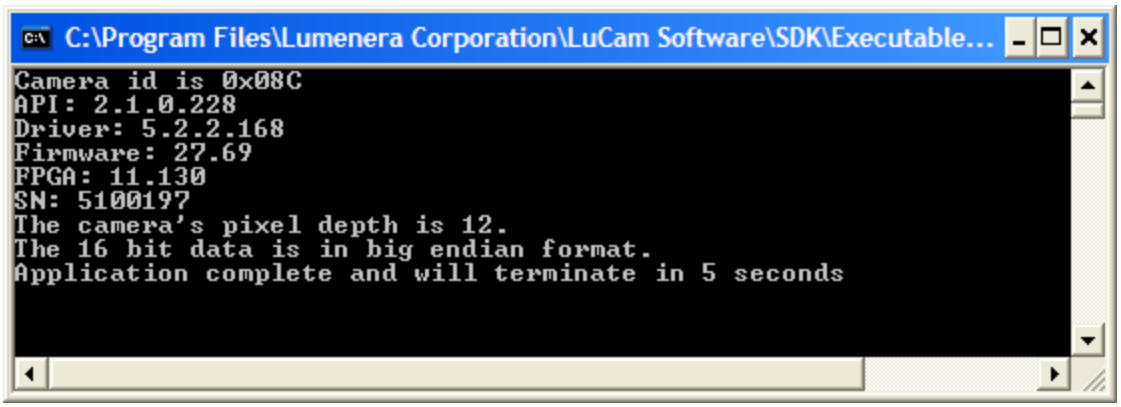
C:\Program Files\Lumenera Corporation\LuCam Software\SDK\Executable...
Camera id is 0x08C
API: 2.1.0.228
Driver: 5.2.2.168
Firmware: 27.69
FPGA: 11.130
SN: 5100197
The camera's pixel depth is 12.
The 16 bit data is in big endian format.
Application complete and will terminate in 5 seconds

Figure 46: Get 16-bit Info Application

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4.17.19 Get Ranges Sample Application

This Visual C++ .Net sample can be used to read and write the camera properties and get their value ranges.

4.17.19.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[x] GigE Vision Products	[ ] MATLAB Sample	[x] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

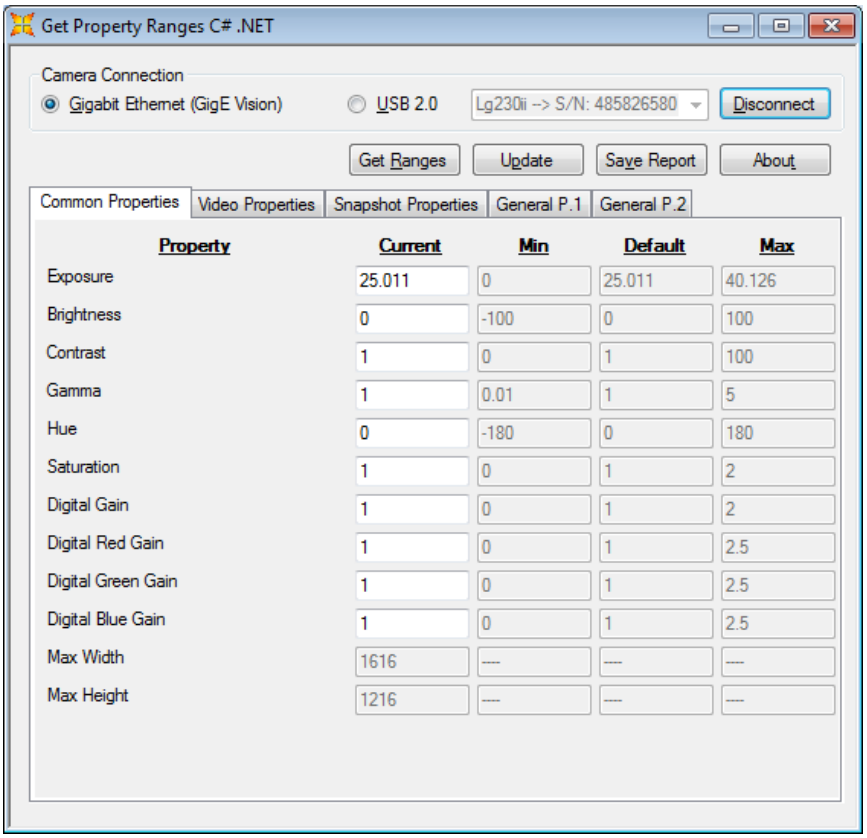

Figure 47: Get Property Ranges Application

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4.17.20 GPI Event Sample Application

This Visual C++ .Net sample code is a console based application that demonstrates how to link an event to the camera's GPI events.

4.17.20.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.21 GPI0 Test Sample Application

This Visual C++ .Net sample code demonstrates how to read the GPI port of the camera and write to the GPO port.

4.17.21.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.22 HiDy Sample Application

This Visual C++ .Net sample can be used to test the High Dynamic Range feature of the Lm085 camera.

4.17.22.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

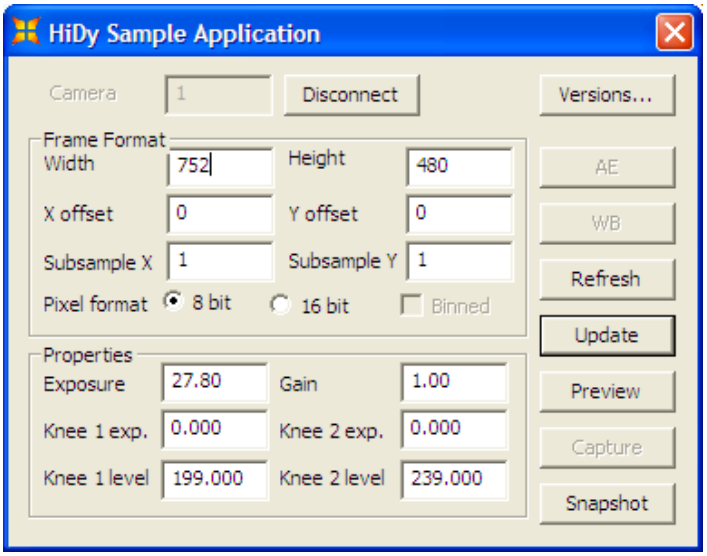

Figure 48 High Dynamic Range Application

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4.17.23 Histogram Sample Application

This Visual C++ .Net sample can be used to generate a text based histogram when images are captured.

4.17.23.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

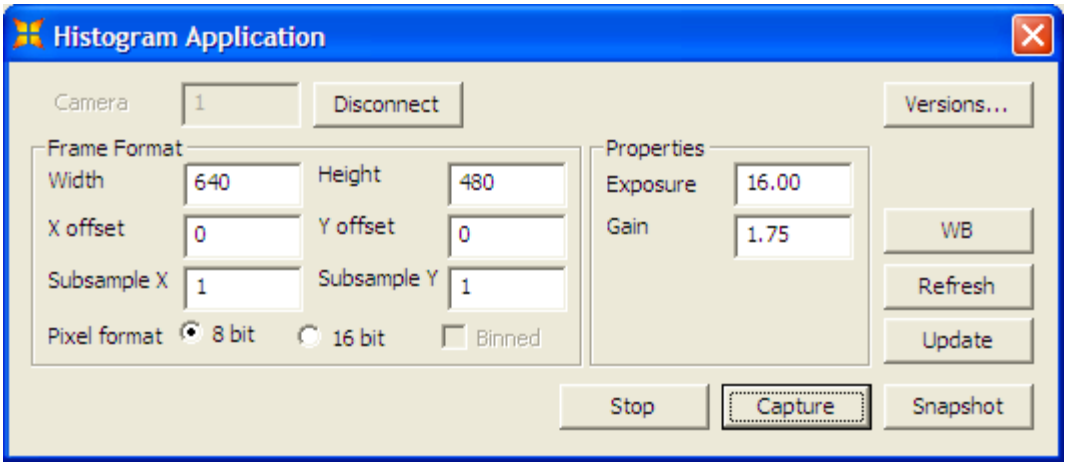

Figure 49: Histogram Application

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4.17.24 HwTrigCount Sample Application

This Visual C++ .Net sample code demonstrates how to configure the camera to use the HW trigger to capture snapshots.

4.17.24.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.25 Infinity Test Sample Application

This Visual C++ .Net sample code demonstrates how to capture DeltaVu type snapshots with the INFINITYX-21 camera.

4.17.25.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.26 Lucam Capture Sample Application

This Visual C++ .Net sample code is the LuCam Capture application that is included with the LuCam Software.

4.17.26.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.27 Mono Check Sample Application

This Visual C++ .Net sample can be used to determine whether the camera is mono or color.

4.17.27.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.28 Picture Flip Application

Pictureflip.exe is a simple application that will mirror or flip the video preview.

4.17.28.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[ ] C++ Base Sample
[x] GigE Vision Products	[ ] MATLAB Sample	[x] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

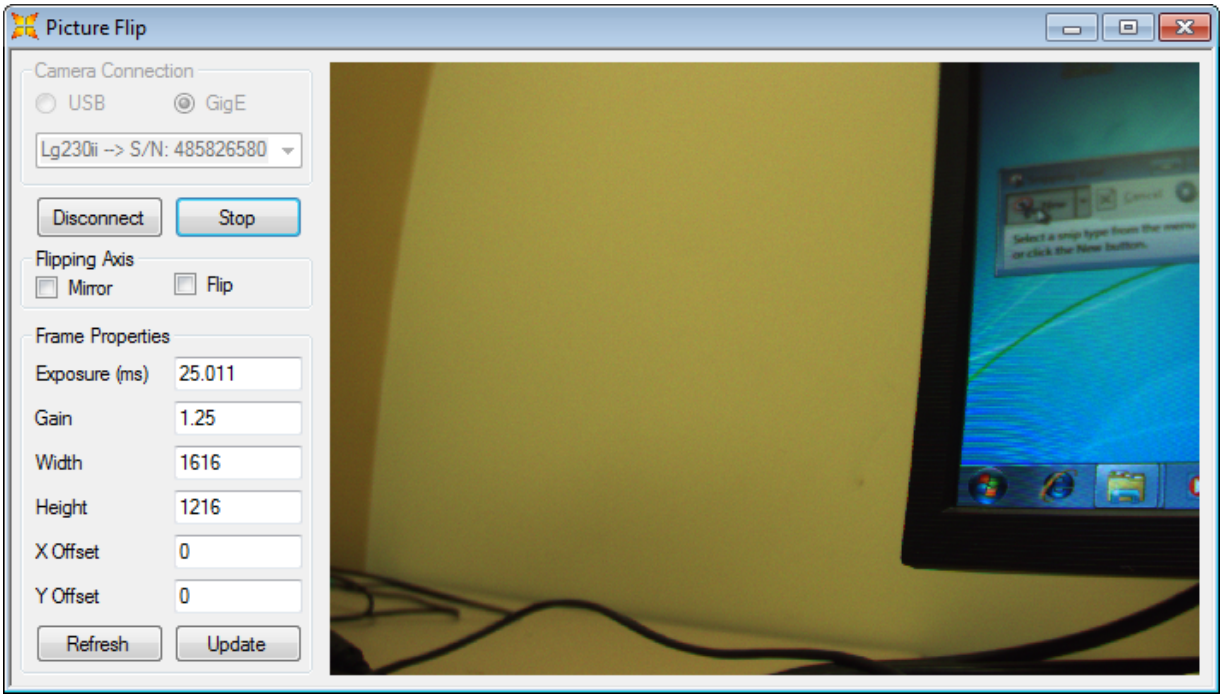

Figure 50: Picture Flip Application

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4.17.29 Perm Storage Sample Application

This Visual C++ .Net sample code demonstrates how to access and use the permanent storage buffer on the camera.

4.17.29.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.30 ResetAndFF Sample Application

This Visual C++ .Net sample code is a console based application that demonstrates how to reset the camera and configure it to perform Fast Frame snapshots.

4.17.30.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] Matlab Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.31 Scrolling Preview Sample Application

This Visual C++ .Net sample code demonstrates on how to create a scrolling preview window.

4.17.31.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] Matlab Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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4.17.32 Snapshot Sample Application

This Visual C++ .Net sample can be used to take snapshots.

4.17.32.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] Matlab Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

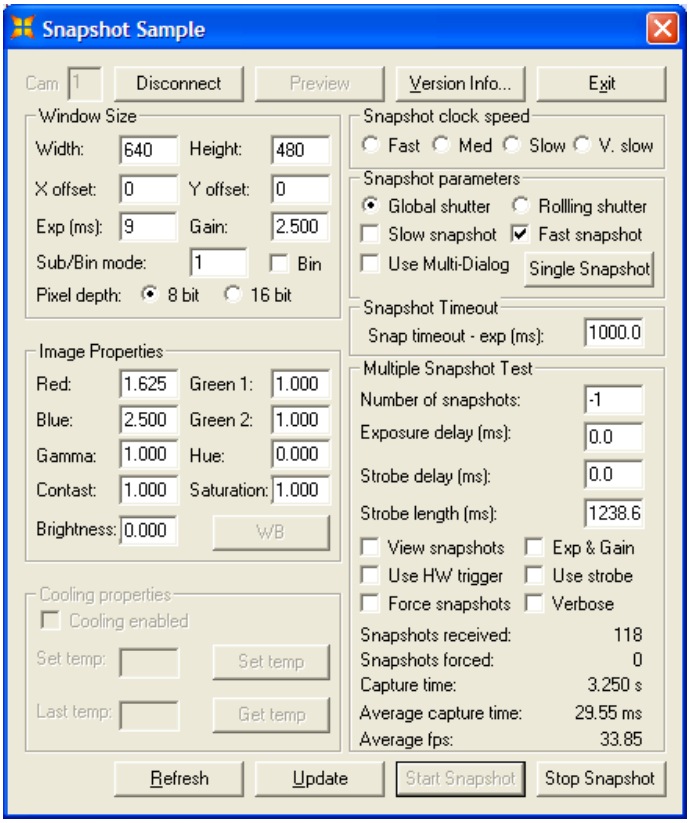

Figure 51: Snapshot Application

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4.17.33 Threshold Sample Application

This Visual C++ .Net sample code demonstrates how to setup the camera to work in threshold mode. In this mode, the camera will only return pixel data that is higher than the threshold value. The data returned include the pixel intensity and its X and Y coordinates.

4.17.33.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

4.17.34 WinConsole Sample Application

This Visual C++ .Net sample code is a generic console-based application.

4.17.34.1 Application Support

[x] USB products	[x] SDK MicroSoft Visual Studio projects	[x] C++ Base Sample
[ ] GigE Vision Products	[ ] MATLAB Sample	[ ] C# Base Sample
	[ ] LabVIEW Sample	[ ] VB Base Sample

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